TO DISCUSS THE FINAL REPORT OF THE NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

(100-56)

HEARING

BEFORE THE

SUBCOMMITTEE ON
ECONOMIC DEVELOPMENT

OF THE

COMMITTEE ON
PUBLIC WORKS AND TRANSPORTATION
HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

SECOND SESSION

MAY 18, 1988

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TO DISCUSS THE FINAL REPORT OF THE NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

WEDNESDAY, MAY 18, 1988

House of Representatives,
Subcommittee on Economic Development,
Committee on Public Works and Transportation,
Washington, DC.

The subcommittee met, pursuant to notice, at 10:47 a.m., in room 2167, Rayburn House Office Building, Hon. Gus Savage [chairman of the subcommittee] presiding.

Mr. **Savage**. This meeting will come to order.

The purpose of today's hearing is to receive an analysis of the third and final report to the President and the Congress by the National Council on Public Works Improvement entitled "Fragile Foundations: A Report on America's Public Works." Our witness is Mr. Peter C. Goldmark, Jr., a member of the five-member Council. Accompanying him is Miss Nancy S. Rutledge, the Council's Executive Director.

Established by The Public Works Improvement Act of 1984 and mandated to terminate as of April 15th, this year, the Council was charged with analyzing and assessing the state of our Nation's infrastructure and providing us with a broad range of information concerning public works facilities owned or operated by Federal, State and local governments. That, of course, was a big mission to be accomplished in a relatively short period of time.

The law required the Council to submit three reports. In the first report, entitled "The Nation's Public Works: Defining the Issues," and submitted in September 1986, the Council provided a summary of the current knowledge of the subject and set the stage for the major public works improvement issues involved for discussion and research.

The second report, submitted in May 1987, consisted of nine consultant studies prepared for the Council in selected major categories of public works. The nine categories were: (1) roads, streets, highways and bridges; (2) airports and airways; (3) mass transit; (4) intermodal aspects of transportation; (5) water resources; (6) water supply; (7) wastewater treatment; (8) solid waste; and (9) hazardous waste management.

Of course, the condition and adequacy of the public facilities that constitute our country's physical infrastructure is something which affects the lives of every single American. Our general health and welfare, our jobs, our ability to function efficiently and productively require that we have sufficient and well-maintained highways, bridges, water supply, wastewater treatment and other facilities. They are basic to our life and economy, to the ability of communities to participate in economic development and to our Nation's ability to compete successfully in the world economy.

Indeed, the job of rebuilding our Nation's public infrastructure is probably one of the most expensive challenges facing us in the years to come. Though our infrastructure problems may vary by types of facilities and geographical location, our public works needs exist nationwide. As the Council's final report infers, the challenges and problems involved are not insurmountable. However, we must reverse the decline of our infrastructure or we will be jeopardizing our Nation's future at a very high cost indeed.

Now, I want to welcome you, Mr. Goldmark and Miss Rutledge, to this morning's hearing. Also I would like to note that Mr. Goldmark is a Vice President of Times Mirror Company, and has long been active in working to resolve our infrastructure problems, and that he was Vice Chair of the Infrastructure Advisory Committee that produced the study, "Hard Choices," for the Joint Economic Committee. Miss Rutledge also has considerable experience and expertise in public works issues, and was former Director of the Washington State Public Works Project.

This Subcommittee looks forward to hearing your discussion about the Council's findings, conclusions and strategies for improving our public works. I expect that this report will prove to be a valuable tool in our National debate on public works issues and our efforts to seek ways to resolve the many problems and challenges facing us.

Because of the importance of the Council's work, we will, without objection, include this report as an appendix to the printed record of this hearing along with the first report of September 1986 entitled "Defining the Issues" and the second report of May 1987 entitled "Executive Summaries of Nine Studies."

First, however, let me turn to my colleague, Mr. Shaw, for any remarks that—oh, excuse me, Mr. Shaw.

Our chairman of the full committee, Mr. Anderson.

Mr. ANDERSON. Please hear from Mr. Shaw first, and then me.

Mr. SAVAGE. All right, Mr. Chairman. It's your pleasure.

Mr. Shaw, any remarks?

Mr. SHAW. Thank you, Mr. Chairman, and Mr. Chairman.

Mr. Chairman, I would like to join with you in welcoming Council member Mr. Peter Goldmark and the Executive Director of the Council, Miss. Nancy Rutledge, who are with us this morning to review the Public Works Improvement Council's activities and the final report.

Mr. Goldmark, it is my understanding that you have done an outstanding public relations job for the Council, and I would like to thank you for being here today. In addition, I have been advised that Miss Rutledge has looked at this issue on the State level and with the Council on the National level. I would be interested to know, as a result of your recent travels in Australia, if you are looking for an international council with which to pursue this issue.

There is little doubt that the Nation's infrastructure is the cornerstone of the economic vitality of our cities and communities. However, this is an issue that has had no or little constituency. The only time public awareness is aroused is under unfortunate circumstances such as when a bridge collapses, potholes become so large that they pose a serious safety danger or when drinking water becomes unusable. As far as potholes are concerned, I've seen some around the Washington area that people can live in, they're so big.

Thus far, there have been many well-meaning and successful efforts to address this issue. For the most part, though, these efforts have been reactionary and somewhat disjointed.

In February of 1984, Federal activity was spurred by the release of the Joint Economic Committee's Report, "Hard Choices". That report projected that $1 trillion will be needed for infrastructure repair, maintenance, and construction through the rest of this century, and that there will be a $450 billion shortfall in revenues needed to meet these needs.

Following up with these findings, Congress took its first major step with enactment of the Public Works Improvement Act, which created the National Council on Public Works Improvement. Its mandate was to review and analyze the state of the Nation's infrastructure and make recommendations to the President and the Congress on what improvements will be needed to support current and expected growth.

The Council's recommendations and warnings were issued in its report, "Fragile Foundations", quite appropriately named. The conclusion of this report is that our infrastructure is scarcely adequate to meet current needs and unable to handle future economic growth and development. It recommends greater maintenance of existing facilities; increased transportation trust fund spending; wider application of user fees; removal of unwarranted limitations on State and local government financing; and capital budgeting at all levels of government.

When we speak of infrastructure, we are talking about the framework upon which communities are built, on which jobs are provided, and on which business and all citizens prosper. This is clearly one of the most important issues facing this Congress and facing our Nation.

Our economic future depends upon a comprehensive plan to improve and expand our Nation's public works facilities. The success of this plan will require the commitment of all levels of government, private sector, and the public. There are major hurdles that must be surmounted. I think we all recognize the improvements that must be made. The true challenge will be in the creativeness and manner with which we finance these improvements.

That concludes my statement, Mr. Chairman. I look forward to hearing from these two fine witnesses, and I now yield back.

[The prepared statement of Mr. Shaw follows:]

STATEMENT OF THE HONORABLE E. CLAY, SHAW, JR., SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, MAY 18, 1988

Good morning Mr. Chairman. I would like to welcome council member Mr. Peter Goldmark and executive director of the council Ms. Nancy Rutledge, who are with us this morning to review the Public Works Improvement Council's activities and final report.

Mr. Goldmark, it is my understanding that you have done an outstanding public relations job for the council, and I would like to thank you for being here today. In addition, I have been advised that Ms. Rutledge has looked at this issue on the State level and with the council on the national level. I would be interested to know, as a result of your recent travels in Australia, if you are looking for an international council with which to pursue this issue.

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This concludes my statement, and I look forward to hearing from Mr. Goldmark and Ms. Rutledge. I yield back to you Mr. Chairman.

Mr. SAVAGE. Mr. Anderson.

Mr. ANDERSON. Thank you, Mr. Chairman.

Mr. Chairman, I have a brief statement and one question. And, unfortunately, because of prior commitments, I can't stay for the entire hearing but, because of its importance, I did want to stop in.

First of all, I would like to commend you, Mr. Chairman, and Congressman Shaw, the subcommittee's ranking Republican member, for initiating this hearing. Of all the issues currently facing the Nation, none may be more critical in restoring long-term economic vitality than the choices embodied in the treatment of our infrastructure.

Whether Democrat or Republicans, we all share a commonality of purpose and responsibility in rebuilding our capital stock. As we look to the future, it should be self-evident to all of us that our economic health rests, to a great extent, upon upgrading basic infrastructure systems. The challenge faces all of us. In the years ahead, we are going to find out whether we have the resourcefulness and the determination to meet it. And together, I believe we can.

Secondly, I want to compliment the Council for the superb work that it has done in the past three years.

Your task has not been an easy one. You have had to deal with very technical and complex issues. You have also had to deal with many diverse organizations, each with its own particular interest and concern.

Through all this, your performance, both as Council members and staff, has been marked by a high degree of professionalism, and your final report, "Fragile Foundations", very well demonstrates that. It confirms both the importance of our infrastructure and the need for increased capital spending.

Few can challenge the assertion that America's infrastructure is stagnant and in need of costly repairs. What emerges from studies like yours is a gloomy picture of an aging America with more than its share of aches and pains. One out of four bridges is considered unsafe. About 65 percent of the interstate highway system is no longer considered in good shape. The average age of the 184 locks on the inland waterway system is 40 years. And the story goes on and on.

And yet the issue is larger than potholes or productivity. What is at stake is the very quality of life for all of our citizens. And to preserve, enhance and improve that, now and for the future, is what infrastructure is really all about.

Mr. Chairman, that completes my formal statement, but I do have one question which I would like to direct to the panel.

In your report, you state that part of the problem is financial, and that an increase of up to 100 percent in the amount of capital that the Nation invests each year in new and existing public works, from $45 billion currently to $90 billion, is what is needed.

My question is this: Has the Council, or have you as individuals with extensive experience in this area, given any thought as to where these funds should come from? And I ask this question, given our frustrations with current spending out of the Highway and Aviation Trust Funds and our past efforts to take these funds off the budget. I just kind of hope that maybe you could tell us where you think these funds should come from.

That is the question I am going to leave you.

And thank you, Mr. Chairman, for giving me this time.

Mr. SAVAGE. Thank you, Mr. Chairman.

[The prepared statement of Mr. Anderson follows:]

STATEMENT OF THE HONORABLE GLENN M. ANDERSON, CHAIRMAN, COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, MAY 18, 1988

Mr. Chairman, I have a brief statement and one question. Unfortunately, because of prior commitments, I can't stay for the entire hearing but because of its importance I did want to stop in.

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My question is this: has the Council, or have you as individuals with extensive experience in this area, given any thought as to where these funds should come from? I ask this given our frustrations with current spending out of the Highway and Aviation Trust Funds and our past efforts to take these Funds off-budget.

Mr. SAVAGE. Mr. Clinger.

Mr. CLINGER. Thank you very much, Mr. Chairman, and I, too, would like to congratulate you and Mr. Shaw for holding this very important hearing. I would like to welcome our panelists to the hearing this morning, and also to commend them for, I think, doing something that is almost unique in the annals of the Federal Government. You came to Washington, you did your job, and you went out of business. That's almost unheard of. I think we still have a Spanish-American War Commissioner out here someplace, but you have done what you intended to do, and I think it is a remarkable achievement.

As has been indicated, this morning's hearing marks one of the concluding chapters of your work. I think in the opinion of most of us, it was a highly successful endeavor that you undertook, and in such a professional way, staffed by a small, dedicated and enthusiastic cadre of professionals who, in a very short period of time, almost an impossibly short period of time, produced a definitive report assessing our Nation's infrastructure.

Public Law 98-501 authorized the creation and funding of the Council, limiting it to a three-year lifespan to sunset on April 15th of this year. The President signed the legislation on October 19th of 1984. Despite the intentions of the bill's sponsors to convene the Council at the earliest possible date, as you were aware, you did not formally meet for the first time until late the following summer because of delays in the nomination of the Council members, specifically the Administration's member was not appointed until that time.

I also want to mention that the Council, though authorized to spend $9 million, completed its work even though it received less than half that funding level. Again, that was a tremendous handicap to work under.

Public Law 98-501 charged the Council with reporting to Congress on the age, condition, and capacity of our inventory of public works. It required you to provide an analysis of the methods of financing used by local governments to build and maintain their public works, and to project how future growth can be accommodated.

The Council's final report, an excellent one, "Fragile Foundations", I think met these ambitious goals. By drawing from a wide spectrum of scholarly research, and by soliciting the input of a large number of experts, and through the commissioning of some very significant studies, the Council has produced the first concise survey on our Nation's infrastructure.

"Fragile Foundations" did receive justly deserved publicity, not enough, in my view, but good publicity. It has heightened the debate on the present and future needs for public works and it has focused public attention on the ability to provide for the economic well-being for present and future generations. Its issuance has reminded policymakers at all levels of the absolute necessity of maintaining a sound and adequate support structure, if you will, for our home and workplace.

I do think, though, that it is incumbent on this committee to assure that your good work does not get put on a shelf someplace, that we are going to need to continue to follow through and keep the pressure on.

Since coming to Congress in 1978, I've spent a good portion of my time personally trying to emphasize the importance of investing in our public facilities. As you are well aware, it is not an easy task.

Especially when competing with problems like the national debt, what do we need to spend on defense, and a host of other social welfare programs, it is tough to keep a high priority on public works. So the work of the Council and your report has, I think, made this task less daunting for us. "Fragile Foundations" has provided this committee with the very persuasive evidence it needs to argue against the trend of diminishing investment.

So we thank you for your hard work, and thank you for being here with us today.

[The prepared statement of Mr. Clinger follows:]

STATEMENT OF THE HONORABLE WILLIAM F. CLINGER, JR., BEFORE THE SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, MAY 18, 1988

Thank you, Mr. Chairman. This morning's hearing marks one of the concluding chapters of the National Council on Public Works Improvement. The Council was, in my view, a highly successful endeavor; staffed by a small, dedicated and enthusiastic cadre of professionals who, in a very short period of time, produced a definitive report assessing our nation's infrastructure.

Public Law 98-501 authorized the creation and funding of the Council, limiting it to a three year lifespan to sunset on April 15 of this year. The President signed the legislation on October 19, 1984. Despite the intentions of the bill's sponsors to convene the Council at the earliest possible date, they did not formally meet for the first time until late the following summer, because of the Administration's delay in nominating its Council Member.

I also want to mention that the Council, though authorized to spend $9 million, completed its work even though they received less than half their funding level.

Public Law 98-501 charged the Council with reporting to Congress on the age, condition, and capacity of our inventory of public works. It required them to provide an analysis of the methods of financing used by local governments to build and maintain their public works, and to project how future growth will be accommodated.

The Council's final report, "Fragile Foundations", for the most part met these ambitious goals. By drawing from a wide spectrum of scholarly research, by soliciting the input of a large number of experts, through the commissioning of studies, the Council has produced the first concise survey on our nation's infrastructure.

"Fragile Foundations" received justly deserved publicity. It has heightened debate on the present and future needs for public works and it has focused public attention on the ability to provide for the economic well-being for present and future generations. Its issuance has reminded policymakers at all levels of the absolute necessity of maintaining a sound and adequate support structure—if you will—for our home and workplace.

Since coming to Congress in 1978, I've spent a good portion of my time emphasizing the importance of investing in our public works. It has not been an easy task, especially when competing against the national debt, defense, and a host of other programs. The work of the Council and their report has made this task less daunting. "Fragile Foundations" has provided this Committee with the persuasive evidence it needs to argue against the trend of diminishing investment.

Thank you.

Mr. SAVAGE. Mr. Boehlert.

Mr. BOEHLERT. Thank you, Mr. Chairman. I will spare you recitation of the eloquent prose assembled by a very able staff and ask unanimous consent that my statement be included in its entirety at this point in the record.

Mr. SAVAGE. Without objection, so ordered.

Mr. BOEHLERT. And also, I would like to commend you, Mr. Chairman, for having this hearing, and I look forward with eager anticipation to the testimony. It is just my hope that, as we look to the infrastructure needs of America, and we talk about the highways, and waterways, and airways, that we do not neglect the railways. I think they are vitally important.

I want to commend you, Mr. Goldmark, and look forward to what you have to say.

[The prepared statement of Mr. Boehlert follows:]

STATEMENT OF HONORABLE SHERWOOD BOEHLERT BEFORE THE HOUSE SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, MAY 18, 1988

Mr. Chairman, members of the committee, on January 15th, 1831 the first American-built locomotive pulled its first train. The train was appropriately named "Best Friend" and the railroads have been our best friends ever since.

Our best friend of yesterday is still this country's best friend today, but if it is to remain an important transportation network we need to include railroads in the infrastructure debate. From the beginning of our nation's history the federal government has provided a variety of subsidies for transportation infrastructure.

At the start, railroads were the biggest beneficiary of federal support. Today, and for the last 30 years, federal support has tilted heavily to the truck and barge mode. Our current policy is to subsidize both. And we are cosntantly adding to that edge through the liberalization of truck sizes and weights, as well as increased speed limits.

The railroad carriers who are locked into head to head competition with the truckers are the regional railroads—a new type of railroad that has emerged from the abandoned lines of Class I carriers. Since 1980, 149 new regionals were created. They operate 8,600 milies of track in 36 states, and employ 5,300 individuals and carry over 1.3 million carloads a year. If the regionals, and the system they are a part of, are to survive, we must make a conscious decision.

We must decide if it is going to continue to be the policy of this government to take traffic off of the railroads and put it onto the highways.

If we believe we need several modes of transportation networks, then we must stop pretending that the railroads will just take care of themselves. One of our focuses must be the railroad infrastructure.

During the last Continuing Resolution passed by Congress, we included a rail infrastructures study proposal, which I authored. It called for the Secretary of Transportation to undertake a study to estimate deferred maintenance and delayed capital improvements on Class II and Class III railroads; analyze the availability of private sector financing to fund these improvements; estimate the traffic that would be diverted from rail to highway if these railroads ceased oepration; and estimate the miles of line currently owned by Class I railroads that are likely to be transferred to new or existing Class II or Class II railroads. And the study will evalaute the impact of the Staggers Act by accounting the actual mileage of lines transferred to create new Class II and Class III railroads since the Act was passed in 1980.

Finally the study should examine the initial assessments of needs for rehabilitation on the class II and III lines, and determine the reasons for any underestimates or inaccuracies.

I urge this Subcommittee to make this study a part of your infrastructure deliberations.

There is no question but that the federal investment in highway infrastructure has had a major impact on American railroading. Further, there is a substantial subsidy to the competing modes. Cost allocation studies at both the state and federal level show a pattern of underpayment by heavy trucks. According to the Federal Highway Cost Allocation Study, conducted by the U.S. Department of Transportation's Federal Highway Administration, the heaviest trucks pay only 65% of their highway cost responsibility.

I believe it can be argued that the national railroad network is as vital to the public interest as is the federal highway network. I would assert that freight transportation by rail achieves benefits that are equal to or better than freight transportation, including minimizing environmental damage and ensuring better and safer highways for the automobile passenger. So we are at a crossroads: We must decide if its right to subsidize one transportation network at the expense of the other. I hope you will decide we can address both issues.

Mr. SAVAGE. Thank you.

Mrs. Bentley.

Mrs. BENTLEY. Thank you, Mr. Chairman.

Mr. Chairman, I will join Mr. Boehlert in sparing you the rhetoric. I ask unanimous consent to include the statement in the record.

Mr. SAVAGE. Without objection, it is so ordered.

Mrs. BENTLEY. I also commend both you and Mr. Shaw for getting this under way. We need it very badly.

[The prepared statement of Mrs. Bentley follows:]

REPRESENTATIVE HELEN DELICH BENTLEY, STATEMENT BEFORE THE SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, MAY 18, 1988

Chairman Savage and Ranking Minority Member, Mr. Shaw, I commend your leadership in arranging this morning's subcommittee hearing to review the final report of the National Council on Public Works Improvement, entitled "Fragile Foundations: A Report on America's Public Works." It is imperative that the Subcommittee on Economic Development continue to discuss and review the present and future infrastructure needs of this nation.

Meeting the demands of our nation's infrastructure will become increasingly important to the Congress. Addressing the build up of our nation's bridges, highways, airports, water projects, mass transit and other vital modes of transportation are directly connected with providing the means of economic development. It we are to be prepared to meet infrastructure financing demands then Congress must be made aware of the projected costs involved in this process.

I look forward to receiving the testimony presented here today and offer my continued support in working with this subcommittee as we review our infrastructure needs.

Mr. SAVAGE. Well, thank you.

Now, Mr. Goldmark, would you proceed.

TESTIMONY OF PETER C. GOLDMARK, JR., MEMBER, NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT, ACCOMPANIED BY NANCY S. RUTLEDGE, EXECUTIVE DIRECTOR

Mr. GOLDMARK. Thank you, Mr. Chairman. Thank you for all of your remarks. I particularly want to thank Bill Clinger for what he said in terms of the staff working hard. They did it. There are five of them here today because, as you said, Congressman Clinger, we did disband the Council and they are here today on their own time because they care about this issue. They have left their new jobs and come here to be present with me today.

Good morning. My name is Peter Goldmark, as the Chairman has told you. Since my appointment by the Speaker of the House of Representatives in 1985, I have served as a member of this Council. So I thank you for this opportunity to present the highlights of the final report, "Fragile Foundations", and I'm just going to give a very short summary of my analysis of its substance and its relevance to the broader and tougher reckoning of the Nation's economic future which is now under way in Washington and in the country.

Mr. SAVAGE. Without objection, Mr. Goldmark, your prepared statement will be inserted upon the conclusion of questions.

Mr. GOLDMARK. Right. Do not panic. I am not going to read it all.

The Congress gave us a tough assignment with this act. We were not asked to replay earlier studies, simply to compile the latest version of the Nation's infrastructure needs. You challenged us to dig deeper and to figure out what the condition of America's public works really was and whether it was adequate to the needs of our economy.

In addition to conducting the prescribed analyses of problems, the Council went one step further. It offered you and the Administration its best judgment about sensible directions that could be implemented at all levels of government. We steered away from specific legislative proposals; that is the job of the Congress, not ours. But we did not duck the basic question of who could and should pay, and how large the bill was likely to be.

So, in response to the central issue of whether the Nation's infrastructure is sufficient to meet present and future economic demand, the Council answers a clear "No, it is not sufficient." We have a substantial and convincing body of research which indicates that our present system is just barely adequate for today's needs, and our current rate of infrastructure investment and improvement falls dangerously short of tomorrow's needs. In other words, America is not in ruins but we are resting on a very fragile foundation for the hopes of the next generation.

We have in this report, as some of you have seen, a report card to try to make this very abstract subject intelligible to most Americans. Overall we gave the system a middling "C." The grades range from a high of "B" for water resources, "B minus" for airports and water supply, to a low of "D" for hazardous waste disposal. The other categories are graded in the report.

But perhaps most troubling of all is the overall pattern of disinvestment in these critical public facilities. What we have been doing is we have been borrowing from the generation in front of us, the generation yet to come. So our centerpiece recommendation is for a sustained national commitment shared by all levels of government, the private sector and the public, to vastly improve America's infrastructure, and this will mean increasing our current rate of public works capital investment up to double the present level. As Chairman Anderson said, from about 45 billion a year to 90. That increase in magnitude we believe is achievable and necessary before the end of the century.

In addition to that core recommendation, here are some other key thoughts I would leave you with.

First, we have to look, think, and act in terms of infrastructure at the three levels of government together. We have to set a national, not a federal, infrastructure policy. I cannot find any single place in the government today where there are people in an institution thinking of all three levels together, in terms of infrastructure policy.

You should also be aware that we found that the United States is the only major industrialized country without a national infrastructure policy.

Number two, we have to focus responsibility and get the lead out. Don't let the different levels of government point their fingers at each other anymore for each major program. Don't let the Fed say to the States, "They're holding it up." Don't let the States say to the locals, "It's their fault." Spell out the role. Put one level in charge of each major program. That is one of our recommendations which so far has been overlooked. In each major functional area, pick a lead level of government, Federal, State, or local, depending on which is appropriate and say, "You're in charge, you're responsible." And try and craft the law so that the other two levels have to support the lead level. And simplify the rules and regulations. That Mr. Chairman, must begin in the Congress.

It took seven or eight years to build the Erie Canal. In eight years as head of the Port Authority of New York and New Jersey, I could not even get a permit to deepen the existing channel in New York Harbor by another ten feet. That contrast was a very, very painful one. Seven years to build the Erie Canal. All I needed was a piece of paper, and I couldn't get it in seven to eight years to deepen an existing channel in this country's greatest port.

Now, those rules and those laws in the end are set by Congress. If you want them administered faster and tougher, and with more accountability, you can do it. If you want them administered slowly, or murkily, or without accountability or focus, you can do that also.

My wrestlings in getting those permits were with Federal branch agencies, but they were all working within laws and within regulations derived from those laws, and with no whip applied to them by the Legislative Branch.

In our report, we ask you to provide for research. We are probably spending less on research in this area than other major industrialized countries.

I am going to read two paragraphs only from the summary, because I think they are important.

The first paragraph I am going to read is the second one in the report. It says this, on page 1 of your summary [Reading.]: "The

Erie Canal, the Transcontinental Railroad, the great dams and water systems of the West, the airports, seaports, and transit systems that serve our cities, our network of modern highways and soaring bridges; all these are part of this country's great public inheritance from the generation of Americans who built before us. These massive and sometimes daring achievements supported the growth of the greatest economic power the world has ever known. They have been the envy of other countries and the model for our competitors. Today that inheritance is in danger."

That's why you asked for this report. That's the spirit in which we are giving it.

The second paragraph is on page 3 in your summary, in the right-hand column. I am going to tell you why we wrote this paragraph. It has to do with Chairman Anderson's question. We are recommending that more money at all three levels of government be spent on infrastructure. We made this recommendation and reached it in the middle of a context where this whole country was in some sort of fiscal gridlock. We said to ourselves, "How are we going to say this? How are we going to express this without appearing to be simply one other special group with its special cause, saying that for our special interest more money ought to be available, in the middle of a hundred interests saying that?"

So we wrote this paragraph, Mr. Chairman [Reading.]:

> There is much to set right in America's house. The Council recognizes that an increased investment in infrastructure is just one among many critical claims on the Nation's resources. To address this claim and others requires that we reckon first with the growing imbalance between consumption, on the one hand, and investment and savings on the other. This imbalance, reflected in the Federal budget deficit and in other forms of borrowing against the future, of which infrastructure is one, affects all Federal spending decisions. The Council supports appropriate actions to redress the imbalance between consumption and savings so that future infrastructure commitments and generations will not be shortchanged.

We did not present you with a plan to close the federal deficit. That's not what you charged us with, and we would have been laughed out of court. But we wanted to say we know this is only one of many things that have to be addressed. We understand that to address the issue you charged us to look at, the gridlock overall will have to be broken. We thought it would have been blind to give you a report on our particular vehicle and not take note of the fact that it was caught in a massive traffic jam with others.

So let me close with this challenge to you. Do you remember why this Council was created? One reason was because the Congress couldn't agree on what to do about the Nation's infrastructure when the issue arose in 1983 and 1984. So you appointed a council to look into it and see whether we, on the council, could agree. We did. A group of very diverse Americans, from East and West; Republican and Democrat; some who had broad experience with infrastructure, some who had little; some from private life, some from public life; some appointed by the President, some appointed by the Congress; this diverse group reached a unanimous conclusion on a direction for the Nation.

So our report to you is: here is the road map that we think makes sense. Our challenge to you is: let's actually start down that road. It doesn't really matter whether you increase funding five billion or ten billion dollars next year. But I believe you must start the process of reinvestment in our life support systems or you will, in effect, be borrowing more from the next generation.

It doesn't matter whether you locate research in the National Science Foundation or in a series of regional universities, but the research must be started. It does matter whether you start reforming the hazardous waste laws and regulations first, or the water project laws and regulations first. But you must make it possible for people to build things again in this country, and you must provide a structure which establishes accountability and entrusts responsibility.

So, ladies and gentlemen of the Congress and of this committee, our report is done. It is strong; it is clear; it is unanimous. With respect but with firmness, we suggest that the ball is in your court.

I will be glad to answer questions.

Mr. SAVAGE. Let me thank you, Mr. Goldmark, and as Chairman Anderson asked, and my main question is: From where do you think the necessary funds shall come for maintaining and improving our Nation's infrastructure?

Mr. GOLDMARK. I think from three primary sources. Let me say first of all that the numbers the Chairman used, roughly 45 billion of capital investment today, to 90, roughly that doubling, those are all three levels of government combined. We felt it very important to keep looking at the three together, because most of the other studies and most of the debate in this government take place at one level at a time. So I want to emphasize that that 45 to 90 is Federal, State, and local combined. We are suggesting three primary sources. The biggest load should be State and local, sir. Most of the public works in this country have traditionally been built and managed by State and local government, and they should continue to be so. That's one of the strengths of our Federal system.

There are some specific functional areas where we suggest the Feds have to take the lead, but if you ask me to assign a rough order of magnitude I would say over half of the total increase should come from State and local government. And I will state to you, in my own personal opinion, without any hesitation at all, that they have that capacity. They will need Federal support, and they will need protection from Federal incursions in their present borrowing capacity. But they can carry their load.

Second source, user fees. There is a passage in this report on the applicability and the principles of user fees.

Third source, general support funds for the Federal share in the Federal budget. That will have to come out of general appropriations, and that, sir, will have to be one of the many claims, one of the many areas in which I believe this country is going to have to decide to spend more.

Mr. SAVAGE. Let me ask: In your investigations in these hearings across the Nation, did you not run into complaints by State and local governments that, because of the present trend toward reducing Federal contributions to the financial needs of State and local governments, including the fact that the costs of State and local governments are increasing, how then do you maintain that the State and local governments are more able to carry a larger share of infrastructure improvements?

Mr. **Goldmark**. I maintain it, sir, based on two things. First of all, and this may surprise you, despite their understandable and regular complaints about cutbacks in Federal aid, most State Governments in this country now understand that the Federal Government is under great financial pressure, and that we are not going to return to the patterns of Federal assistance that existed in the 1960's and 1970's. Most State Governments and Governors and Legislatures understand that they are going to have to carry the largest—not the exclusive, but the largest—share of the infrastructure rebuilding job. They understand that. Many of them, during this period of Federal cutbacks, have sponsored bond resolutions or referenda and gotten them passed, to start just that. And I can cite you three or four governments around the country that have doubled in the past three or four years their level of capital investment in infrastructure.

I am saying, first of all, that the reality is all three levels of government are pinched. The States understand this. They know they're going to have to do more. They have started to do more. And, with relatively few exceptions, I believe they have the capacity to do more. And you are talking, sir, to a person who was budget director of New York State during its most critical fiscal period, when it nearly went bankrupt.

Number two——

Mr. **Savage**. Mr. Goldmark, if I may interrupt. When New York faced this crisis, did it not depend upon major Federal assistance to bail it out?

Mr. **Goldmark**. Yes, it did, and it had the fiscal borrowing capacity to repay all that assistance. Interesting. During that period after the fiscal crisis, and the three or four years after that, New York State and New York City also, doubled, and then in three or four years after that, doubled again their investment in the infrastructure that they had neglected for the 10 or 15 years before the fiscal crisis.

I'm not saying it's easy. I'm saying the State and local governments in this country do have a major fiscal capacity, and the only way it's going to work, sir, is if every level increases their share, not just the Feds.

Mr. **Savage**. Let me ask you, Mr. Goldmark, concerning user fees, which you mentioned. Would you elaborate on your written statement that, in general, they provide a more predictable revenue, encourage better maintenance and more timely rehabilitation and replacement, and support new development in line with actual rates of growth? Because while I can agree about the predictability of such revenues, I am not sure why user fees are better than general revenue in terms of the balance of your statement regarding development and maintenance and so forth.

Mr. **Goldmark**. I think there was considerable feeling among the Council that, in many cases, they are fairer; that the person who uses a bridge, a road, the person who generates waste, the person who flies in an airplane, that the cost ought to bear some relation to what that individual, he or she, does.

There was another reason which was very practical, Chairman Savage, and that is that the States and local governments have far more ability to raise user fees than they do general taxes. And as you imply, if I am reading you correctly, there are some very important exceptions to that, where general funds must be used. Some are obvious, when a community doesn't have the base. Some are not so obvious. And let me give you an example, just so you keep it in the back of your mind.

A strict application of user fees doesn't always work. Suppose when all the runways in this country had to be lengthened for the new jets that the user fee principle strictly applied meant only passengers in the new jets, only the airlines flying the new jets were going to pay for the lengthening of the runways. You can't have progress that way. What you have to say is every airplane is going to help pay for the next generation.

So when you have a technological jump, when you have a qualitative change, you have to spread the user fee principle rather broadly. In effect, that is one way in which one generation invests in the progress of the next.

But about 60 to 70 percent, I think, of public works today in this country are financed by user fees, and one of the reasons we thought it was important was there is an element of market discipline and fairness in it; it is more predictable, which is useful, as you say. And, with the exceptions I stated, the fact is that State and local governments have far more access to it than they do to general funds.

Mr. **Savage**. Let me just conclude, and I may have a few other questions if we have a second round. But I am quite surprised at how high a figure you cite, 60 to 70 percent?

Mr. **Goldmark**. Well, I am counting in that the way the interstate highway system is financed, sir. I am counting those pennies on the gas tax, which is a good chunk of that.

That's why it's useful. What's a user fee? That's a user fee in this sense: you drive a mile, you pay a fraction of the gas per mile into a fund that builds roads.

Mr. **Savage**. How do you rate the general quality and adequacy of current data collection techniques at the various levels of government regarding this matter.

Mr. **Goldmark**. I have to give a general answer to that, sir. Nancy may want to be more specific. Generally, we thought it was pretty weak. I don't want to pretty that up.

Mr. **Savage**. Would you cite a couple areas where we have the greatest lack of information?

Ms. **Rutledge**. One of the areas of particular concern to us is maintenance. We do not have a very good inventory in many of our cities and States of exactly where stuff is, what condition it is, on what basis it's being maintained, the terms or conditions of priorities for that. There are some very clear exceptions, and there are, certainly, a great effort to improve that by many cities and States. But I'm afraid, overall, that the story is, as Peter said, pretty weak. We do not have a good idea until something breaks, and then we find out about it after the fact.

Mr. **Savage**. Let me thank you.

Mr. Shaw?

Mr. **Shaw**. Nancy, following up with your comments, I can tell you, as a former mayor, I know how to hide a lot of things. And all you have to do to help balance your budget is to cut back on some of your maintenance for a few years, then you can run for Congress and let somebody else go in and raise the taxes. It's easy to do.

And I think that you're quite right. I don't think there is any way, until things start breaking, that we do know how bad it is out there, and how much we have neglected our infrastructure.

Also, in talking about the user fees for a moment, I think there is an area that this Congress must address, and I think you are touching on it, and that is the question of where does this money come from that comes out of Washington? Is it free money, or is it money that the community has got to be responsible for?

To give you an example, when we start putting together new sewage plants and pay for them, it is the Federal responsibility to clean up the waters, the expense to the Federal Government never shows up in the bonds, never shows up in the rate structure. That's free money. That's money that's from Washington. That's money you don't have to account for. Where the communities are making their mistake, and where the Federal Government has encouraged them to, I feel, make the mistakes, is by not requiring that the Federal share not be an expense to the Federal Government, but be an investment in our country. To be an investment in our country, it is necessary that those funds be put in the rate structure, that the people do pay for the Federal funds through the water rates, the sewage rates that they pay. These monies should be put into some type of a trust fund which would encourage savings and increase the pool of savings within this country that would be out there and available to be invested. This money would be accumulating so that when that plant became obsolete, or is in need of expansion, or whatever, or just strictly a replacement, there would be funds out there that is available, that have been collected from the users throughout the years.

The Federal Government has never done that. We haven't done that in transportation. We have always made all of that free money. In fact, we even subsidize salaries.

I think what we desperately need to do in this country is to have a realignment of who is responsible for what, and stop the nonsense of these subsidies, because I can tell you, having run local government, there's a lot of creative ways that you can use the Federal share and not really improve the facilities for any permanent improvement but just take care of the day-to-day obligation of State and Federal Government.

I think the pendulum has gone too far to the Federal side, as you, Mr. Goldmark, pointed out, the cities and States are beginning to realize that maybe the game's over and that they are going to have to look more to themselves. I am not sure that they have totally reacted to that realization, particularly when you're talking about the infrastructure. When government owns one bridge and that's its sole responsibility, then that is something that it can readily focus on and take care of that piece of infrastructure. But as the infrastructure expands and has been expanding it becomes much harder to focus on what is needed. Much of the traditional State and local responsiblities have been greatly expanded since the 1950's, with the roadway network, which was an excellent Federal responsibility and should continue as a Federal responsibility, but also with rapid transportation, which I have a little hard time in saying that's a Federal responsibility, even though I know that many of these great subway systems, including the one in this city, probably could not have been built without Federal assistance.

Where do you see—I'll throw this out to both of you—where do you see the realignment of the responsibility of Federal Government, as opposed to State and local government, as to the infrastructure?

I'm probably giving you the makings of another speech.

Mr. GOLDMARK. No. I am going to answer with a couple examples, to help explain to you how we would think about it, rather than go through the whole thing. I think it really depends on the area.

Let me speak—can I speak for myself here in a dialogue?

Mr. SHAW. I wish you would. I wish you would also comment on what I said with regard to user fees. I have stated my opinion. I would like to have yours on the record.

Mr. GOLDMARK. The reason I want to speak for myself is I want to be very strict about when I know I'm representing something the whole Council decided and when I'm just brainstorming with you.

I think you can take an area like local roads, like water resources, and we say in here that the lead for that ought to be with the State, and the other two levels of government ought to have very clear instruction from the Legislative Branch that their role is to help support the lead level and get it done, not to come in on top of it, not to double—supervise it, not to issue a whole new set of instructions.

An example, to me, Congressmen, of one where the Feds ought to take the lead would be hazardous waste, for example. The standards there are so complex. There are poisons out there we don't even understand yet. They travel in rivers, in the air. That, to me, I would use as an example where the lead—I'm not saying the State and the local shouldn't contribute—I am saying the lead responsibility there should be Federal.

We run down, program by program area, and suggest who ought to have the lead in each one and who ought to be support. What's really behind that idea? What I would say is equally important to picking the right lead is the principle that someone is held accountable.

I am guessing, I don't know of what city you were mayor, but I'm guessing you must have had the experience where none of the levels of government thought they were really responsible for any of them. We haven't done that in our Federal system. We don't pin the roles and say you, Mr. Federal, or you, Mr. State, this is yours and the other two levels are going to help you get it done, with money, with support, or whatever.

So there's a chart in here that shows how we would assign each one. That's a very difficult judgment, tremendous political cross-pressures on all of you as you look at that. We understand all that. We are those constituencies. We've dealt with all of them. We try and manipulate them against you sometimes. We understand how complex it is. That principle of accountability is one I would urge you not to overlook in this report. We really do have a system in a lot of these programs where all the levels of government pass the buck to one another.

User fees. I agree with most of what you said. I can tell from your remarks you have, indeed, been a real true, fire-breathing mayor. I think that's great. I wish there were more people in government who had served in more than one level, frankly, Congressman.

With me, user fees are not a theological principle. For many of the tasks at hand, they are a more practical, more accessible way to get it started. I think there are some areas that are going to have to rely on general appropriation. I think it is going to be easier to get user fees for the next round of investment. Maybe that will change. Maybe in 1995 you and I will sit here and say: Gee, the way to go in some of these is general appropriations. I don't think it is theological. I think it is practical, but the user fees are out there and in many cases they can be used in ways more imaginatively than we use them now.

Do you want to add anything to that?

Ms. Rutledge. I would like to just also second your comments about user fees. In fact, the notion of setting up a capital that lasts, that has some durability, was really the principle guiding the development of the Washington State Public Works Trust Fund, which I was involved with. The notion that we had, in the past, raised money through bonds, distributed those monies, and then suddenly they were no longer there. That there was nothing there to hold onto for the next generation of that facility became starkly clear to us, and so we set up a permanent trust fund. And, in fact, it has created a rather significant pool of capital, but what's more, a kind of discipline. No one gets into the pool unless they have established some clear capital planning structures, that they have a maintenance system in place. It is not overly complicated, but it does create that long-term perspective that I think is so important with these facilities.

Mr. Shaw. As part of your report, did you look at the accounting procedures we use and the fact that we don't have capital budgeting, the fact that we expense everything rather than set it up and then go through a depreciation scale like the private sector?

Mr. Goldmark. That varies from State to State. There are some States where the counties have capital budgets.

Mr. Shaw. I am talking now about the Federal system.

Mr. Goldmark. Oh, I'm sorry.

Mr. Shaw. Yes.

Mr. Goldmark. On question of the Federal budget we almost put in there a large recommendation that the Federal Government ought to establish a capital budget process. We tried, very frankly, to avoid the old theological issue about should there be a Federal capital budget. Personally, I find the arguments on both sides of that a little old fashioned and highly stratified.

What I would argue to you is this what is a budget, really? A budget is where competing priorities match claims against each other at one simultaneous moment in time. That is the discipline of a budget. We don't do that well with our capital claims. Most of us on the Council would argue—and we do have some thoughts in here about a capital budget process—that as part of the annual exercise there ought to be a reckoning of all the capital needs—domestic, not defense—and all the domestic capital appropriations, and that the spotlight ought to be held up to that the way it is on other areas of the budget.

Whether those are presented as expense items, or whether they are funded through what amounts to a Federal capital budget, that seems to me less important over the long run. And you are aware of the paradoxes there. Some people like to see a Federal capital budget just because it will reduce the apparent deficit right away. Other people want to do it because they really think it will provide a long-term way to fund long-term problems on a continuing basis.

Yes, I would argue that capital budgeting—you know, like many medicines—can be good or bad, depending on how you do it. But the discipline of looking at the competing claims together, that should be done. And I believe that is not really done now at the Federal level.

Mr. SHAW. Mr. Chairman, I have more questions with regard to that, but I think I have sufficiently set the stage for Mr. Clinger to come in. So I will tag him and go back to my corner.

Mr. SAVAGE. Mr. Clinger.

Mr. CLINGER. Thank you very much, Mr. Chairman. And thank you, Peter and Nancy, for your excellent testimony.

Just following up on Mr. Shaw's question and discussion about the capital budget, it seems to me that one of the purposes that the capital budget process could serve is to assist in one of your objectives, and that is to give clear direction as to who is responsible. I think that through that process you could send signals to State and local government what the Federal role is going to be this year, next year, and down the road. To me the capital budget process, as much as anything, is a planning device, almost more than a budgetary device, because it enables you to give some directions and some signals as to where the Federal Government's priorities and responsibilities are going to lie.

Mr. GOLDMARK. I think that's right. I would suggest that the implication of what you are saying is that process would have to look at spending of all three levels of government together, and that——

Mr. CLINGER. Exactly.

Mr. GOLDMARK. That would be a gigantic step forward.

Mr. CLINGER. And that is not being done in any sense today. At least, that has been my observation, that we have, three different spending paths here, which are not coordinated, which are not working together, and when you have most of the States working on a capital budget system, and the Federal Government working on a year-to-year basis, it's very difficult to get any kind of coordination in the overall objective, which is to have a coordinated effort addressing the infrastructure prices, and we just don't have that.

It has been noted here that you didn't get all the money that you were entitled to, to carry out your responsibilities. What would you have done if you had full funding? In other words, what do you think needs still to be done? Did you finish the job, or are there things that you would have liked to have done that you couldn't do?

Mr. **Goldmark**. That's a great question because you'll hear me and Nancy give different answers. My answer is going to be this, that this is the fourth or fifth study in this area, and the broad lines are really pretty clear. The question is: do we have the nerve and the will to do it? If we had had more of the money originally appropriated to us, I, as one Council member, would have voted to use it on more public education and more hearing.

It is a difficult problem to understand. It is one, as former Mayor Shaw said, that can always be put off until tomorrow. That's how I would have used it, not on more study. I can make a list of a hundred things that should be studied further. But our central finding is we're borrowing from our kids. We're gonna leave them a bunch of potholes and rusted bridges. And we ought to stop the borrowing and build for them as your and my parents built for us. That's the central message. And it is more important to start that than to do the next hundred studies. Of course the data is not perfect, of course there is stuff missing, but that will always by the case.

Some of your colleagues will not agree with this, even some of your colleagues who created the Council. I think the smartest thing we did was not go out and do another needs study, not go out and try and count every rusting bridge, you know, in the country, every rotting water main. We'd still be out there.

Mr. **Clinger**. And that was certainly the objective of some of the people——

Mr. **Goldmark**. Some of the——

Mr. **Shaw**. Will the gentleman yield to me for just a minute?

Mr. **Clinger**. Yes.

Mr. **Shaw**. You struck a note as to what Mr. Goldmark just said with regard to what our parents left. The problem I think that we are seeing is that we have expanded the role of government into some very worthwhile activities. The human infrastructure, for instance, we are doing a lot more in that area than we ever were before. And I think one of the problems is going to be one of balancing what our needs are and what we should be doing so that we are looking to build a better infrastructure both from the human side and from the structural side for the future, instead of continuing to pursue a policy of containment, making people feel good, but also making them stay exactly where they are.

There is a lot to be done. Some of the greatest advances this country ever made in public works was during the Depression. But the philosophy then was to put people to work, give them an opportunity to produce something and be paid for their effort. We seem to have lost sight of that and have created a sort of a massive problem which makes our infrastructure concern only a small part. Government is doing a lot more than our parents ever envisioned that government could or should do.

But I think the problem is we have institutionalized so many of these expenditures that we have really lost the vision of building for the future instead of just building in segments of two years, as Members of Congress run for election.

I appreciate it.

Mr. **Clinger**. That underscores, I think, a point you made very well, and that is the real need here to identify who is responsible for what. Because it has been my observation, as former Chief

Counsel at EDA that where you don't have the taxing responsibility where you are not going to be criticized for having used taxes for a purpose, you can kind of do almost anything. An example I am thinking of is something called the Local Public Works Program which was a countercyclical program back in the late 1970's. It was a hundred percent Federal money. But total selection of projects at the local level, which meant that a lot of things in the normal order of priorities, would not have been built got built, because the local government wasn't really responsible. It didn't have to answer to anybody as to what they were doing it for, and so they could build a Miss America Hall of Fame, I remember was one of the projects we had, and a few other things.

But a lot of those projects are not doing very well, I can assure you. And, in fact, I was appalled to discover the other day that we're still wrapping that program up at EDA. It never finished. But it just seems to me that there is a real need to hold the local elected officials responsible for what they're doing, and the way to do that is to make sure that they're answerable to the people that are paying the money to do the project.

Nancy, I got the indication that there might be two different answers to my question about what you would do.

Ms. RUTLEDGE. No, in fact there wouldn't be a different answer. I think we spent as much money as we could practically use in terms of looking under every rock in regard to the infrastructure issue. I think we did that pretty thoroughly. There are some fine points, obviously, we could have pursued. But, in terms of giving you guidance, and I hope useful information for your considerations, I think we did exhaust that.

But I would also agree with Peter very strongly, in terms of public education, that was really beyond our scope.

Mr. CLINGER. Right.

Ms. RUTLEDGE. By the same token, that was the one area I was left with the strongest sense that we needed to do a much better job. We talked to each other all the time, that the community is very good at discoursing about this, but typically, the audience are the same old faces. And, in fact, the people that really are making the decisions are taxpayers, rate payers, local officials who oftentimes are not part of the discussions but should be, and probably would be if they understood the implications of them.

Mr. CLINGER. Well, I couldn't agree more. I think the fact that we need to do a better job of educating and making people aware that there is a direct connection between the quality of your public facility and your ability to have economic growth, to be competitive, if you will. We are talking quality of life here, which not many people realize. It is not something that people really focus on.

In that regard, I think one of the persuasive things that we can do in this area is to talk about what our competitors are doing, what Japan is doing in terms of investment in public facilities, and what the Europeans are doing. We view competitiveness as the buzz word these days, and a very hot one, and if we can make that contrast that we're really doing much less than some of our major competitors who recognize that linkage between quality public facilities and the ability to have growth, quality of life, we may be able to turn this around.

Do you agree with that?

Mr. GOLDMARK. I certainly do. We took a crack at that, Congressman. There is a section of a chapter in here on what the other OECD countries are doing. Very difficult intellectual terrain. How do they count what the different levels of government spend? But essentially, you're right. All of them spend a higher percentage of GNP on this than we do. All of them have a national policy. We not only don't have a national policy, we don't even have a Federal policy.

But that gets back to accountability.

Mr. CLINGER. Right.

You stressed the need for all State, local, and Federal governments to do a better job. But you also talked about the involvement of the private sector as a key player in the solution to this problem.

I wonder if you could elaborate just a little bit more on how you see them. I know that there are some very interesting things going on now with private sector involvement, but I wondered what you had in mind.

Ms. RUTLEDGE. If I may, Mr. Clinger, on that point. The private sector, you know, has been talked a lot about in terms of private financing of infrastructure, and that is certainly an element that continues to get some interest, although there is not a whole lot of examples yet to point to. It does represent potentially a trend in the future, particularly as development is held up by the absence of infrastructure.

I think that perhaps the most important role the private sector can play is understanding better the role between public capital investment and private capital investment and serve to be the major spokespeople for the issue. Now, in terms of not just the people who directly benefit from infrastructure, but essentially the broader scope of manufacturing and business commercial services who really depend upon that infrastructure being there and to provide timely delivery, you know, to get goods to market, to provide all those services.

The other area that I think is particularly important in terms of the private sector, and certainly a growing trend, although it's very uneven across the country, is a private sector up front, particularly development up front financing of infrastructure. Where growth is occurring at a fairly rapid pace, certainly we can see that around here very strongly, the private sector should be paying up front, the developers should be paying up front for the cost of that, not necessarily the whole freight, but certainly an equitable share of it.

Many States, I know Maryland and the State of Washington, and others, have taken the lead to establish guidelines here so that it doesn't become a form of extortion, but indeed, helps to guide growth or infrastructure to meet growth. And I think that serves as potentially a very lucrative source of infrastructure financing in the growth areas of our country.

Mr. CLINGER. Just one other question. I think my time has nearly expired.

You talk about the removal of unwarranted limits on the availability of tax-exempt financing for State and local self-help efforts.

I want to put in, perhaps, a minor plug for a bill that I have introduced which might aid in this effort. It seems to me that the Tax Reform Act of 1986 did some grievous harm to the ability to use tax—exempt financing for infrastructure projects, at the same time that we were reducing grant-in-aid programs and Federal assistance for a whole range of infrastructure items. We also took away the ability of communities to finance these projects on their own.

In particular, I have a bill in that would rescind the arbitrage provisions.

Would you think that would be of assistance in this effort? Is this the sort of thing you were thinking about when you said that you needed tax reform?

Mr. GOLDMARK. That is the sort of thing. I think you and some of the other leaders in Congress have been very foresightful in identifying where the problems are. I think they are fairly clear. The question is: where is the atmosphere to do something about them. That is a political problem for all of you.

If I could enunciate a general principle it would be this. Congress was right to go after the easy stuff, the abuses, the McDonalds, the discos that were being financed, that was right. That was terrible. And the State and local governments asked for trouble on that. So they got trouble.

Let me suggest as a counterproposal that, I don't see why there should be any limit whatsoever, from the Federal point of view, on how much a State or local government can borrow for what I would call pure infrastructure. I mean, if we want to see investment in this country, I don't see why there should be any ceiling at all. And some of those caps, the way they are structured, are, in fact, stopping investment.

Mr. CLINGER. Very harmful.

Mr. GOLDMARK. Yes.

Mr. CLINGER. Well, thank you, very, very much. I just commend you again. I like all of your recommendations. I am certainly going to try to work to implement some of them through legislation. And you can be assured that I will be your champion in terms of trying to promote the causes for which you have done such a marvelous job.

Thank you.

Mr. SAVAGE. Let me pick up, Mr. Goldmark, on something that I think was mentioned by Mr. Clinger, on public concern. Do you have any suggestions on how we can stir up public support to act on some of these problems. The public, as you know, may get upset about a bridge collapse, as in New York, or a traffic gridlock, but no one has yet marched on Washington to demand something be done about the state of our infrastructure. I wondered if you have any suggestions along that line.

Mr. GOLDMARK. I have two suggestions, sir. They are only suggestions. Unlike all of you, I have never run for elective office. I have worked for governors and mayors, and I have the greatest respect for that distance between being right on the firing line and being in the chair behind the person who is. I've always been in the chair behind. So that is why these are only suggestions.

When I give speeches, I find good reaction to the following approaches. Number one, much better reaction to rebuild and repair than to grand new systems. And if you go to the Northeast, with which I am most familiar, when a governor or mayor went out and tried to get a referendum in favor of a bond issue, when he said, "This is to rebuild what we've got, this is to keep it so it's working," the people understood that, because they were driving over the potholes every day, and they voted for that one.

When he went out and said, using an example from a large nameless Northeastern State, "This is for a new subway line to Outer Galactica, or to Jupiter," it got voted down.

Rebuild and repair—I think people understand that. I think they have learned. Nobody ever demonstrated in favor of it, but that rings a bell. And, with the exception of the hazardous waste area, that's the largest part of what we are talking about.

Number two. I found a curious range of people reacting to my next suggestion, and that's one reason in the report. Not only when I give speeches. When I was briefing the Speaker of this House on this report, since I was, in fact, his predecessor's appointee, he was walking around behind his desk with those beetle brows, and then, I remember when I made this point, he suddenly stopped and looked. I said, "You know, what we're really doing is that we're borrowing from our children." 'And when you take people through that,' he said, do they really see it? That we're borrowing from our own children?"

This is another form of deficit financing. We just haven't called it that. They're going to have to repair them. They're going to have to rebuild them. They're going to pay the price, one way or another, in backed up sewer lines, or in repairing later and more expensively what we didn't repair today.

That, I think, strikes a chord. I don't know if those were the kind of things that your question was aimed at, but we wrestled a great deal with it. How do you talk about this so it isn't abstract, dry, billions for pipelines underground that nobody ever sees?

Those are my two suggestions: to build and repair, and we've got to stop borrowing from our kids. Our parents didn't do it to us. They left us a great inheritance.

If we were called to account today for what we're leaving to the next generation, we'd all get a "D."

Mr. SAVAGE. That gets us back a bit to my earlier question about the user fees, when you get into the question of borrowing, and the whole matter of financing our infrastructure needs. May we return to that subject? How do you feel about the unprogressive nature of user fees as a source of public revenue, particularly in light of your suggestion, that we should depend more on user fees, with regard to infrastructure improvement and maintenance.

Mr. GOLDMARK. I am a very pragmatic individual in that regard. There are some user fees which in effect are much fairer and more progressive than they seem. I don't see why anybody who flies in an airplane shouldn't pay for those airports through a user fee. I've got no problem with that.

And is that a little bit unprogressive? Yes, it's a little bit unprogressive, but not a lot unprogressive. And in the huge scale of things, does that bother me a great deal? No.

Mr. SAVAGE. But, Mr. Goldmark, I'm more concerned about those water bills, and so forth.

Mr. GOLDMARK. And that's going to be my second example, water.

Now, who has a right to clean water in this country, and drinkable water? Everybody.

So that's one—that was literally going to be my second example. And there you want to make sure that you use user fees in a way that don't burden those who have low incomes and can't afford it easily. I mean, a person earning ten thousand or fifteen thousand dollars has just as much right to clean water as a person earning $150 thousand. And those costs or levies very often are regressive.

Does that mean you shouldn't use user fees to finance part or all of that system? No, it doesn't. I believe what it means is you should use them and, in combination with the rest of your tax system, make sure that the whole thing is progressive.

The reason I say that, Mr. Savage, is because for a lot of these things you're going to have to use user fees to get them done. You're going to have to. All other routes will be blocked to you. And, therefore, you've got to use them intelligently and sensibly, and offset them with other measures.

Mr. SAVAGE. Let me ask one more question. Are you satisfied with the balance between the input, of so-called experts, as contrasted with the input of persons who, as you say, are more on the firing line, government officials, who have to deal with some of these problems with regard to funding?

Do you understand the question?

Mr. GOLDMARK. I think so. Tell me if my response gets off base and come back at me.

In terms of the exercise we went through, we heard a broad range, we heard a lot of elected officials. We had an elected official on our Council, at least one.

Did we have more than one?

Ms. RUTLEDGE. No, one.

Mr. GOLDMARK. We had one. And he's gotten elected again, sir, so we didn't kill him.

If you ask me, to be very candid, on what the big, most important, missing link is, I said in my testimony that we are the only industrialized country that doesn't have a national infrastructure policy. And I think we have to have that challenge and that goal set by an administration, by the Executive Branch of the Federal Government acting with the Congress. It is very hard for this country to undertake a sustained, massive task if the President of the United States doesn't at some point say, even if it's something as broad as, "This is important, we have to focus on it." It can be done. Sometimes with one strong and united voice the Congress can do it, but the Congress has not been united on this issue so far.

I believe if a President were to get up and say, "We're borrowing from our kids. Expenditures of this money, while it will be difficult, while it will require breaking the fiscal gridlock and all these issues, will, in fact, create jobs and more tax revenues. It's worth doing, it's got to be done from now to the end of the century," I think it's easier than it looks.

And so, the greatest single missing ingredient I think is that national vision of what that policy would be and where it's got to take us. And I think if that were articulated, a lot of the other pieces would come along more easily.

Do you know how many people there are signing up to be teachers now, just because for the past two years we've had national leadership saying teaching is important again? Kids are signing up to be teachers again.

Mr. SAVAGE. And you feel that the input from such people, national leaders, and so forth, in elective office, that the input was sufficient on balance with——

Mr. GOLDMARK. In terms of the report?

Mr. SAVAGE. That's right.

Mr. GOLDMARK. Yes, sir; I do.

Mr. SAVAGE. Thank you.

Mr. GOLDMARK. We touched all bases in that regard.

Mr. SAVAGE. Mr. Shaw?

Mr. SHAW. Thank you, Mr. Chairman.

Did you all have an opportunity, or are you qualified to venture an opinion as to how we compare with other industrialized nations of the world?

Mr. GOLDMARK. Not as firm and sure as I have been in some of the other things, because we took a pretty superficial look, but we deliberately went out to look at the OECD countries. We spend less as a percentage of GNP than the other countries on our infrastructure.

Japan has a very interesting system. They have two kinds or bonds at the federal level, one for the deficit, and one for capital investment. When you buy a bond you know which one you're buying. I'm not suggesting that here. I'm suggesting that's indicative of a frame of mind and a focus on policy. And that really brings me to my second point, Mr. Shaw.

We are the only industrialized country that has no national infrastructure policy. And that worries me. And that's not to say what it should be, but we're the only one without one.

Mr. SHAW. Mr. Chairman, I would like to ask unanimous consent that a statement by Mr. Hammerschmidt, the ranking Republican member of this committee, be inserted in the record.

Mr. SAVAGE. Without objection, so ordered.

[Mr. Hammerschmidt's prepared statement follows:]

STATEMENT BY THE HONORABLE JOHN PAUL HAMMERSCHMIDT, ECONOMIC DEVELOPMENT HEARING, MAY 18, 1988

Good morning Mr. Chairman.

I would like to join with you and Mr. Shaw in welcoming council member Peter Goldmark and the executive director of the council Ms. Nancy Rutledge.

At the outset, let me say that the council has done an outstanding job. The analysis they have undertaken of the complexities associated with a national policy regarding infrastructure will serve as a blueprint for this issue.

Infrastructure is an issue which is crucial to the future of our country, and one with which I have discussed personally with the Vice President.

The council's final report opens appropriately by stating that the quality for the Nation's infrastructure is a critical index of its economic vitality. A healthy, vibrant economy and the well-being of all Americans is dependent on reliable transportation, clean water, and the safe disposal of wastes.

The Public Works and Transportation Committee has played a leading role in formulating a comprehensive infrastructure policy. The committee's activities began with the passage of the Public Works Improvement Act of 1984 which created this council. A great deal of credit is due to Representative Clinger for his efforts on this important issue.

And, of course, we must pay tribute to our late chairman Jim Howard, who was clearly a leader in Congress on this important on the need to improve our infrastructure.

The council's final report now provides us with a series of recommendations and guidelines with which to follow. Unquestionably the country's economic future depends on a comprehensive plan to improve and expand our Nation's public works facilities.

Again, I woud like to thank the witnesses for being here this morning, and I look forward to their testimony.

Mr. SHAW. Mr. Chairman, I would like to congratulate the witnesses. I am not sure whether they were appointed by Mr. Reagan or Mr. O'Neill. Coming from me, that's a compliment, by the way.

Mr. GOLDMARK. We'll take it as such.

Mr. SHAW. I have certainly enjoyed what I've heard. Even though I am greatly disturbed by it, I think it's about time that this be put on the table. I think the last remark that Peter made with regard to the fact that we're the only major industrialized nation without a plan, if you will—how did you phrase that?

Mr. GOLDMARK. I said without a national policy.

Mr. SHAW. Without a national policy as to infrastructure is frightening. I guess we do have one, but it's called consumption.

Mr. GOLDMARK. Well said.

Mr. SHAW. Thank you, Mr. Chairman.

Mr. CLINGER. Mr. Chairman.

Mr. SAVAGE. Mr. Clinger.

Mr. CLINGER. A follow-up on that.

Can you give us some idea of the flavor, or some of the components of, the national policies of industrialized nations?

Mr. GOLDMARK. I can give you some elements. If you wanted to go further than that, I'd suggest you give the OECD Secretariat in Paris, you know, two months advance notice, say, "Send us over two people who will give us a rundown of the major industrialized countries."

Mr. CLINGER. I'll go over there.

Mr. GOLDMARK. Well, I phrased it more delicately, sir. But I'll give you some of the elements of the best, not the universal.

The best places have all the levels of government integrated. In Germany they know what the central government does, what the Larden do, and what the local level does. That's all worked out. It's pretty messy here.

Second of all, many of them, not all, do have multiyear funding plans and horizons, so that once a project is started, it's not caught up in the annual appropriation process. I mean, it would never happen there to go—how many years did we go here without a water projects bill?

Mr. CLINGER. Eleven.

Mr. GOLDMARK. Eleven. That would not happen under that system, because it's done on a multiyear basis.

Those are some of the positive elements. They spend more on research. This is something that is difficult sometimes. People will say, "Why is research necessary?" It has to do with efficiency, competitiveness, and technology. And, in fact, you know, a little money on research may reduce the overall bill we were talking about. If you can reline a water pipe or sewer pipe, just reline it with a plastic insert the way you put a plastic baggy in your trash can at night, rather than rebuild and relay the whole pipe, you may save millions.

And we used to be in the forefront, this country. We used to be the ones they would come visit to see how to do it.

What's the next one?

Mr. **Clinger**. I think your point about how you can get the public to support a rebuilding operation was a very good one, and very true. And yet, for many years the Federal programs all were skewed toward new construction. It was a real bias against rehabilitation, repair, and maintaining an existing facility.

Mr. **Goldmark**. That's right. I've worked at the State and local. I've sat around the same tables former Mayor Shaw did, and said, "How can we make this old rebuilding project look like a new project so we can get some Federal money for it?"

Mr. **Clinger**. So that you get the money. That's exactly right.

Well, I think we are gradually changing that perspective, and I think that's a plus.

You talked about one of the potential sources for funding was impact fees, and I wonder if you could elaborate on that a little bit, what you have in mind in terms of developers paying impact fees?

Ms. **Rutledge**. Well, I should say at the outset that there are some cautions on that point, that developer fees are not a panacea. There can be some problems in regard to low and moderate income housing, and so on. But in general terms, for both commercial and residential properties, in effect by a prescribed plan, with certain guidelines, so that they are held fairly, exercised fairly, that the developers, in effect, pay the cost of new development related to their expansion. So that that is an after-the-fact cost of local government. Unfortunately, when we pay for it after the expansion has already taken place, oftentimes retrofitting it is much more expensive.

Again, there are very specific guidelines. I think that there are some very good works on that area at this point that could help guide other States. I think it is very much a State issue rather than a Federal issue. But it does serve to provide a major source of funding in areas that have begun to use it in an ongoing, credible fashion.

Mr. **Clinger**. What about, for example, where you have a Corps of Engineers project for port development, which those surrounding the port will benefit from. It is clearly going to be for their financial benefit that that project go in. Would you say that there should be some sort of a tax imposed upon the beneficiaries of the port project even though it might be somewhat indirect?

Ms. **Rutledge**. Yeah. There are any number of instances around the country where those beneficiary areas are established and taxed in a fashion that is——

Mr. **Clinger**. Special use areas?

Ms. **Rutledge**. Yes, right.

Mr. **Goldmark**. Some of them, particularly developments, might be of great interest to Mr. Savage, because some of those turned out to be indirect taxation that is very progressive. When you are taxing the developers, you ask who are they really passing it on to. They are passing it on to folks with more money.

Mr. CLINGER. Thank you both, very, very much, for a very interesting morning.

Mr. SAVAGE. We have a vote pending, but we should be able to just wrap this up in about five minutes, and we won't have to return. In doing so, let me just express a concern, to which you don't need to respond at this hearing, but I would appreciate any response you do have to be submitted later. That is, when you encourage a greater dependence upon States and locals for responsibility in financing of projects, there is a problem. Because of the differences, the wealth of different States and local governments, you have to be very careful, as a consequence of increasing their role, that it is not a distinct disadvantage to those States and local governments who most need infrastructure improvement and maintenance because of the fact that they are poorer than other States and cities. That's why we have the Appalachian Regional Commission, and operations such as that.

However, let me just say to you, Ms. Rutledge, I want to commend you as the Council's Executive Director, for your time, talent, and extraordinary effort in producing this report. It certainly is a major piece of work and will be a useful tool to guide us, all of us who have special responsibility regarding infrastructure issues and needs.

Yet, now that the report has been filed, just briefly, is there anything about which you now think differently or would have done differently?

Ms. RUTLEDGE. No, Mr. Chairman. I think—obviously, I have learned by some of my mistakes, or maybe by a lot of my mistakes along the way. But I think in terms of covering the issue in a fashion that I feel satisfied with, and the fact, particularly not just the body of work, but, in fact, we have been given a pretty strong endorsement by a very broad range of organizations who, I can tell you quite honestly, were not thrilled with us along the way, but at the end were willing to say, "Yes, this is a credible starting point for our discussions from this point on." I think that, for me, was the toughest challenge and the one that I am most grateful for having accomplished.

Certainly there are more things to learn about this subject than we, perhaps, covered. But I think we went as far as we could in the time we had.

[The prepared statement of Mr. Goldmark follows:]

STATEMENT OF PETER C. GOLDMARK, JR., MEMBER, NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT AND SENIOR VICE PRESIDENT, TIMES-MIRROR CORP., TO THE SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, U.S. HOUSE OF REPRESENTATIVES

Good morning, Mr. Chairman and Members of the Subcommittee on Economic Development. My name is Peter Goldmark. Since my appointment by the Speaker of the House of Represntatives in 1985, I have served as a member of the National Council on Public Works Improvement. Thank you for this opportunity to present the highlights of the Council's final report. I would also like to offer my analysis of its substance and its relevance to the broader and tougher reckoning of the nation's economic future underway now in Washington and throughout the country.

As most of you know, the Council's final report to the President and the Congress, *Fragile Foundations*, was released on February 24, 1988 after two years of exhaustive research, public outreach and broad critical review. The final report represents an accurate distillation of that process. More importantly, it represents a remarkable consensus among the five very diverse members of the Council on the state of America's infrastructure and appropriate strategies for improvement. It has also been favorably reviewed and widely distributed by members of our formal Advisory Group and numerous public interest, trade and professional groups.

Finding consensus was not easy. In fact, it was downright grueling. The Council was appointed by both the White House and the Congress and naturally reflects a broad political spectrum. We did not come to the task as advocates or "true believers" on the nature or the magnitude of the nation's infrastructure problems. Nor did we have any agreement at the outset on how we should address these problems. For that matter, neither did anyone else. The so-called "infrastructure choir" rarely sings in the same key or with any discernible harmony.

The Congress gave us a tough assigment with the Public Works Improvement Act of 1984 (P.L. 98-501). We were not asked to replay earlier studies—to simply compile the latest definitive version of the nation's infrastructure "needs." Instead you challenged us to dig deeper and to figure out what the condition of America's public works really was and whether it was adequate to fuel our present and future economy.

In addition to conducting the prescribed analyses of problems, the Council believed that it was also obliged to go one step further and to offer its best judgment about sensible directions that could be inplemented at all levels of government. We steered away from specific legislative proposals; that is the job of the Congress. Nevertheless we did not duck the basic questions of who could and should pay for public works improvements

Let me briefly review the Council's findings for the record. In response to the central issue of whether the nation's infrastructure is sufficient to meet present and future economic demands, the Council answer a resounding "NO." We have a susbstantial and convincing body of research which indicates that our present system is just barely adequate for today's needs. And our current rate of infrastructure investment and improvement falls dangerously short of tomorrow's needs. In other words, America is not in ruins but we are creating a very fragile foundation for our children's hopes and dreams and the nation's continued economic growth.

To describe some of the specific dimensions of this fragility we developed a national report card to grade each category of public works. The report card is not intended to be a sophisticated analytical tool; rather it conveys important information in a simple and universally understood fashion. It represents a judgment and a caution for the future that can strike terror in every student's (and parent's) heart.

Overall the system gets a middling "C." The grades range from a high of "B" for water resources (including ports, dams, canals and flood control), "B minus" for airports and water supply, to a low of "D" for hazardous waste disposal. The other categories—highways, mass transit, wastewater treatment, and solid waste disposal all cluster between "C minus" and "C plus." While these are not highly quantified assessments, they have held up remarkably well to critical review by some of the nation's leading experts in each category.

Perhaps more troubling than the problems associated with individual categories is the overall parttern of disinvestment in these critical public facilities. No single indicator—such as percentage of public works spending in relation to GNP—is necessarily significant by itself. But as you perceive the same downward trend in a variety of economic indicators and you can actually see increasing physical evidence of deterioration and congestion, it doesn't take a math wizard to figure out that America has a potentially seious problem.

Our centerpiece recommendation is for a national commitment, shared by all levels of government, the private sector, and the public, to vastly improve America's infrastructure. This means doubling our current rate of public works capital investment. We believe that an increase of that magnitude is achievable and necessary for the nation as a whole by the end of this century.

We recognize that the federal government faces immense fiscal difficulties for the foreseeable future. However we argue that it must remain a significant and reliable partner in this effort to increase and sustain public capital investment. In many ways, disinvestment in public works is as serious a national problem as the budget and trade deficits. All three represent threats to the future of our economy and our children's livelihoods.

The Council is not arguing in favor of simply throwing money at the problem. In order to convince the American public to dig deeper to pay higher rates or taxes, we have to do a better job of planning and managing the nation's public works. We need to establish more clearly who is accountable at each level of government for making and following through crucial decisions. We need to make federal and state mandates more flexible to allow cost-effective methods of compliance. We need to promote stronger incentives and support for proper maintenance, and we need to accelerate technological innovation. Finally we need to have a rational capital budgeting process at all levels of government.

The keystone of our strategy to finance public works is the benefit principle—those who benefit from public works should pay for them. This is not a dogmatic idea; there are situations—such as low-income or hard-to-serve communities—in which various types of assistance may be necessary. But in general, user fees provide more predictable revenues, encourage better maintenance and more timely rehabilitation or replacement, and support new development more in line with actual rates of growth.

The Council does not propose or endorse any gigantic new federal spending programs, but it strongly supports an expanded federal role in terms of leadership, research and development, and capital formation. It must also pay close attention to the impact that federal laws and requirements have on the ability of state and local government to finance infrastructure

State government, for its part, must invest more in sustaining local infrastructure—particularly in small cities and farm communities that are hard-hit by economic downturns. States should also closely examine the impact of their tax limitations on local fiscal capacity. We cannot insist that city and county officials pay more of the freight for infrastructure if they do not have the basic revenue and financing tools to do the job. Finally, the private sector—especially the development community—should pay its fair share of the up-front cost of new infrastructure. We have learned too many times that the infrastructure catch-up game played in many of our major cities right now is horrendously expensive and inefficient.

There are no villains or scapegoats in the Council's report. Like Pogo, we have looked at the enemy and it is us. I hope that our work will serve the Congress and the Administration well. I also hope that it serves as a useful guide and inspiration for those individuals who are on the firing line for all the basic public works services we depend upon every day. Thank you.

Mr. SAVAGE. In conclusion, I want to also commend you, Mr. Goldmark, and your fellow Council members, for the kind of civic concern that led to you and your fellow members volunteering time over the past three years or so, in an effort to help us in government. That kind of partnership between government and the private sector and an outstanding citizen such as yourself can lead to some conclusions that can really get us on the way to addressing what is indeed a very serious problem.

Let me thank you again for your time and for your statement.

Mr. GOLDMARK. Thank you.

Mr. SAVAGE. This hearing is adjourned.

[Whereupon, at 12:07 p.m., the subcommittee adjourned.]

THE NATION'S PUBLIC WORKS

Defining the Issues

Report to the President and the Congress

National Council on
Public Works Improvement
September 1986

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National Council on
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September 1986

The National Council on Public Works Improvement

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Preface

This is the first of three reports by the National Council on Public Works Improvement, which was created by Public Law 98-501, The Public Works Improvement Act of 1984 (see Appendix A). In that Act, Congress asked for a thorough evaluation of the state of the nation's infrastructure.

This first report . . . provides an overview of current knowledge and establishes a broad context for further discussion and research.

This first report is an initial step toward the requested evaluation. It represents a *reconnaissance* of the major issues explicitly and implicitly posed by P.L. 98-501. The report provides an overview of current knowledge and establishes a broad context for further discussion and research. The second report will provide additional analysis of the most critical and promising issues. In the third and final report, the Council will present its conclusions and propose strategies for improving the nation's public works infrastructure.

Although America's infrastructure is among the most advanced in the world, it is not among the best maintained. Constant attention to keeping it in good condition is essential if the nation is to continue to grow and prosper. Meeting the challenges posed by international competition, major economic, demographic, and technological changes, and citizens' expectations for public services requires great vision and stewardship. Precisely how the nation's capital investment and maintenance requirements should be met is unclear at this time; that will be the subject of the Council's continuing investigation and final report.

The immediate challenge to the Council is not simply to produce reports, but to communicate effectively with the public, especially those involved directly in public works issues, in order to determine critical needs for improvement and develop workable, well-supported strategies for meeting them.

The ideas and information presented in this report are drawn from the many sources listed in Appendix B, as well as the experience of the members of the Advisory Group (set by P.L. 98-501) and their respective staffs. The Council wishes to thank all of these individuals who were part of its reconnaissance effort. Without the materials and encouragement they supplied during the first phase of the Council's work, this report could not have been completed.

Special thanks also go to the U.S. Army Corps of Engineers for logistical support in establishing the Council's office and for the assistance it provided to the Council.

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Chapter I Introduction

The condition, safety, and responsiveness of . . . infrastructure are a reflection of national commitment.

Public Law 98-501 created the National Council on Public Works Improvement to report to the President and the Congress on the state of the nation's infrastructure. As the first of the Council's three reports, *The Nation's Public Works: Defining the Issues* presents the results of a broad survey of public works issues and analyses.

A major finding of this survey is that the infrastructure issue has matured since the first sensational news reports began to focus attention on the national infrastructure "crisis." Public concern has moved beyond simple physical evidence of deterioration to include the economic importance of public works facilities. Increasingly, it is understood that the condition, safety, and responsiveness of the nation's infrastructure are a reflection of national commitment to maintaining a healthy and competitive business climate, improving the quality of life, and providing a sound economic future for generations to come.

Because expenditures for public works generally compete with many other public and private spending demands, resources for capital investment and maintenance always will be limited. Deterioration, congestion, or other significant evidence of unmet public works needs reflect not only these fiscal constraints, but also basic resource allocation issues, such as:

- normal tensions between long-term investment and maintenance requirements versus immediate service demands;
- continuing shifts in responsibilities among Federal, state, and local governments and the private sector for planning, financing, constructing, and maintaining public works; and
- growing demand for economic productivity on the part of public capital investments.

This chapter reviews the Council's legislative mandate, offers a working definition of infrastructure, describes the Council's objectives and the scope of its work, and presents an overview of the issues that will be developed more fully in the remainder of this report.

The Council's Legislative Mandate

Creation of the National Council on Public Works Improvement by the Public Works Improvement Act of 1984 (P.L. 98-501), see Appendix A, carried with it several specific reporting requirements. Legislative guidelines in Section 103(a)(1) of the Act directed the Council to conduct an analysis of the following issues:

- the age and condition of public works improvements and changes in their condition from preceding years;
- methods used to finance the construction, acquisition, rehabilitation, and maintenance of public works improvements, including but not limited to general obligation and revenue bonds, user fees, excise taxes, direct governmental assistance, and private investment;
- trends in methods used to finance such construction, acquisition, rehabilitation, and maintenance;
- the capacity of public works improvements to sustain current and anticipated economic development and to support a sustained and expanding economy; and
- maintenance needs and projected expenditures for public works improvements.

In addition, the Act directed the Council to:

- discuss infrastructure program priorities (including alternative methods of meeting national infrastructure needs to effectuate balanced growth and economic development);
- analyze criteria and procedures used by Federal agencies, states, and units of local government in inventorying existing and needed public works improvements and assessing the condition of public works improvements, and develop and publish uniform criteria and procedures that may be used for conducting such inventories and assessments; and
- develop and recommend to the President and the Congress proposed guidelines for the uniform reporting by Federal agencies of construction, acquisition, rehabilitation, and maintenance data with respect to public works improvements.

Congress directed the Council to use existing data whenever possible. If new data must be developed to address these issues, the Council was instructed to work with state and local governments to assure that such data would be developed using uniform methods, categories, and analysis.

In carrying out its responsibilities, the Council has found that available data are not adequate to answer some of the questions raised in P.L. 98-501 about the age and condition of the nation's public capital stock, the changes in condition that occur from year-to-year, or the implications of such changes for future maintenance requirements. Rather than utilizing unreliable or incomplete data, the Council intends to work with representatives of Federal, state and local government and other experts in the public works field to build a methodology and establish incentives for the generation of appropriate data for use in the policy-making process.

Defining Infrastructure

In the broadest sense, the nation's infrastructure is the physical framework that supports and sustains virtually all economic activity.

The nation's infrastructure is the physical framework that supports and sustains virtually all economic activity.

Facilities with the following general characteristics—high fixed costs, strong links to economic development, long service life, interaction with other parts of a system, and public ownership—may be termed *public works infrastructure.* This definition usually includes, at a minimum, facilities for transportation, water resources, and waste management.[1]

Because of their lengthy planning and construction schedules and high fixed costs, major infrastructure projects usually involve a greater degree of uncertainty and higher financial risks than typically short-term industrial and commercial investments. Generally, infrastructure projects require some form of public financing. Once built, such projects have near monopoly power in local markets. They are often also part of a larger system, such as a national road network or a regional water supply system. To protect the economic and safety interests of the public, governmental regulation and coordination are often involved in infrastructure development.

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[1] For now the Council has made these three major types of facilities priorities in its discussion of infrastructure. However, Public Law 98-501 defines "public works improvements" in a more expansive fashion to include the following publicly owned civilian facilities: highways; streets; bridges; mass transportation facilities and equipment; resource recovery facilities; airports; airway facilities; water supply and distribution systems; wastewater collection, treatment and related facilities; dams; Federally owned buildings; docks and ports; waterways; and such other public facilities as the Council determines are critical for national economic development. Because of time and resource constraints, the Council did not expand the definition to include other important components of the nation's capital assets (such as hospitals, schools, jails and court houses) but focused its priority attention on certain facilities mentioned in the legislation (with the exception of Federally owned buildings). Future developments may expand the types of infrastructure commonly in the public domain to include such facilities as those for telecommunications and space travel.

In this context, infrastructure policy can be expressed in terms of alternative capital investments to provide a desired level of safety and service over a specified time period. The specific means of achieving desired levels of service—whether to construct, reconstruct, rehabilitate, repair, or maintain particular facilities—are not as important as the service levels themselves. The physical condition of facilities is relevant to the extent that it has a bearing on the quality, reliability, safety, and cost of services now and in the future.

Council Objectives and Scope of Work

The Council's mission is (1) to improve understanding of the condition, safety, and capacity of the nation's public works facilities, and (2) to enhance the process of resource allocation.

The Council's mission is twofold: (1) to improve understanding of the condition, safety, and capacity of the nation's public works facilities, and (2) to enhance the process of resource allocation. These goals are fundamental to assuring that investment in public works is adequate to sustain the well-being and economic viability of present and future generations.

The Council's principal activity in the next year and a half—prior to its scheduled termination on April 15, 1988—will include the preparation and submission of two additional reports to the President and the Congress. Those reports, respectively, will (1) analyze key public works issues identified in this first report, and (2) suggest practical approaches to meeting the nation's essential infrastructure needs in the future.

In developing this and its future reports, the Council is providing an active forum for debate and consensus-building among representatives of Federal, state, and local governments, the private sector, and citizens regarding public works needs and effective strategies for improvement. Only through the continuing efforts and with the constant enthusiasm of all of these parties can the nation meet the challenge of providing a safe and efficient infrastructure.

An Overview of Infrastructure Issues

This initial report is supported by 32 background papers, listed in Appendix B, and other materials prepared for or collected by the Council in its survey of infrastructure issues in America today. The issues that emerged may be grouped into three categories: (1) decision-making, (2) technology, and (3) economics (including finance). Each set of issues is explored in the body of this report and summarized in the final chapter. The following brief overview sets these issues in relation to one another.

Decision-Making

Decision-making issues involve a complex mixture of politics and management. Both are integral parts of the whole subject.

Numerous studies of public works . . . have concluded that a significant gap exists between needs and available funding.

Political attention was drawn to the infrastructure issue several years ago by a series of studies that focused on the nation's public works deficiencies. The discussion of decision-making in this report begins with an evaluation of the contributions of those studies and their potential for improving infrastructure policy. That evaluation leads to consideration of the changing roles of governments and the private sector that set the framework within which day-to-day public works decisions are made. The more technical management practices including standard setting, planning, budgeting and resolving conflict also are addressed.

Needs Studies. In recent years, numerous studies of public works needs at all levels of government generally have concluded that a significant gap exists between needs and available funding. Besides drawing public attention and framing the terms of discussion, these studies themselves are part of the debate. The definition(s) of "needs" and the methods of projecting them into the future have generated many questions.

These types of studies are reviewed in Chapter II in terms of their current contribution to policy decisions and their potential value at various levels of government.

Decision-making about public works in the American federal system is a complex and fragmented process . . .

Roles of Government and the Private Sector. Decision-making about public works in the American federal system is a complex and fragmented process, involving Federal, state, and local governments[2], private sector participants, and the public. Most of the 80,000 units of state and local government are divided into two or three branches that have semi-independent roles in financing, regulating, or operating public works.[3] In addition, in many parts of the country advisory organizations and procedures have been established to coordinate provision of public works among jurisdictions.[4]

Chapter III describes current issues in reassessing Federal, state, and local roles, and in evaluating current proposals for changing the existing pattern of public works responsibilities. Such issues include the present and prospective capabilities of state and local governments and the private sector to take on new functions.

Management and Decision-Making Practices. The nation's infrastructure depends ultimately on people—elected and appointed officials and their technical staffs—who make thousands of decisions every day on the size, shape, and condition of their respective systems. The issues involved in strengthening their capacity to manage and make decisions that are timely, efficient, equitable, and politically accountable are explored in Chapter III.

New technological developments . . . hold substantial promise for improving the productivity, performance, and durability of public works.

Technology

New technological developments—including new materials, construction methods and information and communication systems that support better decision-making—hold substantial promise for improving the productivity, performance, and durability of public works. The extent to which these opportunities can be realized quickly may depend, in large measure, upon the nation's ability to find ways to: (1) accelerate research, testing, and development, (2) improve the means of disseminating information, and (3) overcome barriers to the use of innovations by reevaluating current standards and practices. These are described in Chapter IV.

Economics and Finance

Public works construction, maintenance, and operation constitute a significant sector of the nation's economy. That sector, in turn, enables other sectors to operate effectively and efficiently. In this respect, the nation's public infrastructure both delivers a major set of physical services and has significant economic impact.

The economic benefits of public works are important to the nation's growth and its competitiveness in international markets.

The economic benefits of public works are important to the nation's growth and its competitiveness in international markets. In addition, they significantly effect the competitive positions of individual states, localities, and business firms. Thus, the economic issues connected with public works must be weighed in national and regional settings as well as at the local level.

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[2] Five types of independent local governments are recognized by the U.S. Census—counties (3,041), municipalities (19,076), towns and townships (16,734), school districts (14,851), and special districts (28,588).

[3] At the local level, the executive and legislative branches frequently are combined in a single political body—the council, board, or commission.

[4] These include such mechanisms as regional planning councils and intergovernmental consultation processes.

Fiscal scarcity has begun to shift infrastructure financing responsibilities among the Federal, state, and local governments.

Fiscal scarcity has begun to shift infrastructure financing responsibilities among the Federal, state and local governments. Heightened concern over finances increasingly is raising questions about the degree to which public works should be funded out of current revenues or through debt instruments. In addition, tight public budgets are tending to shift funding responsibilities to the private sector, to direct beneficiaries from the general public, and from present users of facilities.

A serious and continuing quest has been under way for several years to adjust the wide variety of available financing tools to these changing conditions. Efforts to reduce the Federal deficit and changes in the Federal tax system have lent greater urgency to the exploration of new means of supplying the funds needed for essential public works improvements.

These finance trends and economic issues are described in Chapter V.

Chapter II Needs Studies

The condition of the nation's infrastructure has been the subject of several major studies in recent years. Although the availability, comparability, and reliability of their data have been questioned, these studies significantly increased public awareness of the vastness, deteriorating condition, and importance of the nation's capital stock. They also challenged state and local governments to look more closely at their own capital investments.

This chapter examines the changing concept of public works needs, reviews the findings of major national needs assessment studies, summarizes current needs assessment practices at the Federal, state, and local government levels, and outlines the issues and potential improvements suggested by this analysis.

The Concept of Public Works Needs

The concept of "need" with regard to infrastructure often is used loosely by researchers, government officials, and the media to describe capital investment and maintenance requirements. The same term can refer to upgrading structurally deficient bridges as well as to constructing new water distribution systems to spur economic and population growth.

Unlike chemical reactions or engineering tolerances, which can be predicted accurately to within a small range, no agreement has been reached on the nation's infrastructure requirements. It is not known, for instance, how much infrastructure the nation, or a particular region, must have to maintain economic viability—although we do know that the United States is dependent on its infrastructure, and that the absence of adequate public facilities eventually will stifle economic activity. Most of the ground-breaking national infrastructure studies have concentrated on identifying the extent of the problem and estimating the cost of repair and renewal. Not surprisingly—given different local preferences, limited availability and reliability of inventory and condition assessment data, and varying standards for gauging the cost of restoring capital facilities to good condition—no universal agreement exists on what national needs are.

No agreement exists on what national needs are.

Because of these inherent difficulties, needs estimates have been criticized as being not so much a statement of baseline requirements for satisfying objective criteria but more of a "wish-list."

A more realistic approach to the assessment of needs would consider such issues as: (1) consumer demand for infrastructure services; (2) recognition that such demand changes (sometimes before capital assets are worn out or paid for); (3) consumer willingness to pay for services; and (4) benefit-cost analysis, including the cost of alternative strategies for meeting public works requirements. Cost estimates that reflect demand for services and manageable alternatives might yield a truer, more rational, and perhaps more affordable estimate of infrastructure needs than current techniques, which are based on a mixture of construction and performance standards, and rules of thumb not always agreed upon by public works professionals. In fact, sometimes there may not be sufficient justification to repair or replace a dilapidated facility or build a new one where none existed previously. For example, the U.S. Army Corps of Engineers has indicated its recent experience shows that when local communities are asked to pay an increased share of the cost of water resource projects, they often scale back the size and scope of the projects significantly.

This refocused way of thinking about needs also could prompt a change in the character of the infrastructure debate; rather than concentrating on the development of rigorous national standards for evaluating infrastructure conditions, future research might attempt to establish investment priorities and preferences for service levels. Although traditional evaluations of infrastructure condition may be necessary to determine national infrastructure needs, and certainly are a good place to start, by themselves they are not sufficient because they do not evaluate alternative service strategies.

In sum, most popular accounts of infrastructure needs have not addressed issues that normally surround large financial investments, such as their costs and benefits, the consequences of not investing, ability to pay, and other options. These shortcomings are due partly to the preoccupation of early studies with producing complete, comprehensive, and reliable estimates of national needs—a very difficult task. However, by not outlining the consequences of choosing different levels of services or suggesting alternative strategies, these studies have proved to be of limited use to policy-makers who simply cannot afford to commit to this wholesale "needs" concept.

The Council intends to explore the extent to which the concept of needs and the manner in which they are estimated can be refined to better inform the infrastructure debate.

The Council intends to explore the extent to which the concept of needs and the manner in which they are estimated can be refined to better inform the infrastructure debate. It also will examine the appropriate form of nationally recognized standards for this purpose, and of assessing demands for infrastructure services at a state, regional, or local level. The latter approach might shift the focus of the debate away from quantifying the aggregate size of needs to stimulating the setting of investment priorities. The importance of such a possible change makes it useful to review in greater detail what the Council has gleaned thus far from needs studies, the problems and opportunities they present for decision-makers, and the further issues they raise.

Review of Recent National Needs Studies

Needs studies undertaken from the late 1970s to the present have provided considerable information about the nature and relative magnitude of the nation's infrastructure requirements. The first generation of studies concluded that the United States needed to accelerate its investments in public capital facilities to save them from deterioration. Many researchers who have produced these studies or critically evaluated their results agree that:

- the nation's vast infrastructure has been maintained unevenly;
- many public facilities have not been maintained adequately and are in sufficient disrepair to pose risks to public health and safety;
- the problem is widespread, not confined to a few categories, or certain cities or geographic areas; and
- the cost of meeting future demands for public infrastructure will be very high.

The first generation of studies . . . point to a serious national problem . . .

Despite the different approaches and assumptions used in these studies, in the aggregate they point to a serious national problem. Although their estimates of the actual dollars required to address the problem vary widely, the studies agree more closely on the relative distribution of needs across infrastructure types. For example, all studies show that the amount needed for highways and bridges is greater than the amount needed for mass transit.[1] However, this and other findings discussed below are based on needs defined by forces external to the community—e.g., engineering standards, legal mandates, or generally accepted construction practices. They do not reflect the concept of needs discussed earlier, which is based on demand and includes factors such as local priorities and the community's willingness to pay.

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[1] George Peterson, Ted Miller, Nancy Humphrey, and Christopher Walker, *Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement, July 1, 1986.

. . . important subnational differences . . .

Although research has shown the infrastructure problem to be national in scope, it also has called attention to important subnational differences. For example, both older northeastern cities and western agricultural areas may have significant water distribution system needs, but the specific nature of the problems, and the capacity to develop solutions, frequently differ.

Comparison of Three National Needs Studies

Transportation improvements account for between two-thirds and three-fourths of required funding.

A comparison of three of the most frequently cited national studies—the reports of the Associated General Contractors (AGC), the Congressional Budget Office (CBO), and the Joint Economic Committee (JEC)[2]—shows close agreement in the relative rankings of infrastructure needs but wide differences in the dollar amounts (see Table II-1).[3] In all cases, transportation improvements account for between two-thirds and three-fourths of required funding, compared to drinking water, which accounts for between 6 and 14 percent of basic infrastructure needs.[4]

Drinking water accounts for between six and fourteen percent of basic infrastructure needs.

When the studies are analyzed in terms of the shortfall between investment requirements and estimated available revenues, the AGC study reports the largest annual expenditure gap for the infrastructure categories cited in Table II-2 ($71.7 billion, or approximately three-fifths of comparable projected needs). The CBO estimates are lowest at $17.4 billion, while the JEC figures are somewhat higher, at $24.6 billion per year. Highway needs account for the majority of the investment shortfalls. Here again, the actual dollar amounts vary, but each study points to large annual shortfalls.

It should be noted that the needs estimates cited in these studies predate recent highway spending increases. Although still well below historical levels, total road and highway expenditures are estimated to have risen 46 percent between 1982 (the base period for these studies) and 1986, while Federal budget support rose 58 percent between FY 1982 and FY 1986, mostly due to the 5-cent gasoline tax increase.[5]

Special Analyses of National Needs

The studies cited above do not differentiate between urban and rural needs; nor do they reflect the Federal government's views about its role in providing funds to meet them.

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[2] Associated General Contractors of America, *America's Infrastructure: A Plan to Rebuild*, May 1983; Congressional Budget Office *Public Works Infrastructure: Policy Considerations for the 1980's*, April 1983; and *National Infrastructure Advisory Committee Report to the Joint Economic Committee of Congress*, February 1984.

[3] The AGC study figures are nearly always larger, since extrapolations were made for many categories of investments for which needs studies or projections are not readily available, such as local roads, sewer lines, and drainage improvements.

[4] A more recent national needs study summarizing the five major modes of transportaiton for the ten-year period 1987-1996 is: American Transportation Advisory Council, *ATAC III: New Directions in Transportation* (Washington, D.C.: October 1985).

[5] George Peterson, et. al., *op. cit.*

TABLE II-1
THREE NATIONAL NEEDS STUDIES:
COMPARISON OF ANNUAL CAPITAL INVESTMENT REQUIREMENTS
(in billions of 1982 dollars)

Infrastructure Category	ACG Study (19 yr. ave.)[a]	CBO Study (1983-90)	JEC Study (1983-2000)
Highways and Bridges	$ 62.8[b]	$ 27.2	$ 40.0
Other transportation (mass transit, railroads, airports, ports, locks, waterways)[c]	17.5	11.1	9.9
Drinking water	6.9	7.7	5.3
Wastewater treatment	25.4	6.6	9.1
Drainage	5.6	NA	—[d]
Total	$ 118.2	$ 52.6	$ 64.3

[a] The time frame for addressing needs varied by specific infrastructure category from 5 to 25 years and averaged 19 years.

[b] Highways only. Bridges were estimated separately at an additional, one-time repair cost of $51.7 billion.

[c] Needs for locks and waterways were not available from the JEC study, and needs for railroads were not available from the CBO study.

[d] Included under wastewater treatment.

Source: *Peterson, et. al., Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement by The Urban Institute, July 1, 1986.

TABLE II-2
THREE NATIONAL NEEDS STUDIES:
COMPARISON OF ANNUAL CAPITAL INVESTMENT SHORTFALLS
(in billions of 1982 dollars)

Infrastructure Category	ACG Study (19 yr. ave.)[a]	CBO Study (1983-90)	JEC Study (1983-2000)
Highways and bridges	$ 44.8	b	$ 14.7
Other transportation[c]	4.8	b	4.9
Drinking water	4.5	b	2.3
Wastewater treatment	18.4	b	2.7
Drainage	NA	NA	—[d]
Total Shortfall	$ 71.7	$ 17.4	$ 24.6
Total Shortfalls as a percentage of total needs	60.7%	33.1%	38.3%

[a] The time frame for addressing needs varied by specific infrastructure category from 5 to 25 years and averaged 19 years.

[b] Shortfall figures for individual infrastructure categories were not specified, but are included in the total.

[c] Other transportation includes mass transit, railroads, airports, ports, locks, and waterways. Shortfall estimates for railroads were not available for the CBO study, and shortfalls for mass transit, airports and ports were not available for the AGC study. Neither the AGC nor the JEC study estimated the shortfall for locks, waterways, dams or the air traffic control system. These, however, are maintained in CBO's estimate of total annual shortfall.

[d] Included under wastewater treatment.

Source: *Peterson, et. al., Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement by The Urban Institute, July 1, 1986.

Rural Needs. Relatively little information has been assembled systematically on the availability and condition of public facilities serving rural America.[6] One large study, the National Rural Community Facilities Assessment Study (NRCFAS), commissioned by the Farmers Home Administration of the U.S. Department of Agriculture, did attempt, on a limited basis, to inventory the availability and capacity of selected rural infrastructure. Researchers subsequently have suggested that the data collected were too limited to support reliable estimates of the investment needs of rural communities.[7]

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[6] J. Norman Reid and Patrick J. Sullivan, "Rural Infrastructure: How Much? How Good?", *Rural Development Perspectives*, October, 1984, p. 10. Patrick J. Sullivan and J. Norman Reid," "Rural Infrastructure: A Look at the Policy Issues," paper for U.S. Joint Economic Committee, *Readings in Rural Development*, December 1985, p. 9.

Issues concerning rural areas and small towns have surfaced in the infrastructure debate.

Nonetheless, issues concerning rural areas and small towns have surfaced in the infrastructure debate. Most frequently, these concern the fiscal capacity of small communities to construct and maintain an adequate level of infrastructure services. Some researchers suggest that in periods of fiscal stress, rural communities, like their urban counterparts, may defer maintenance; however, no evidence exists to support arguments that rural infrastructure deterioration is widespread.[8]

A Federal View. The U.S. Office of Management and Budget (OMB) is required by the Federal Capital Investment Program Information Act of 1984 to prepare a supplement to the Federal budget, projecting Federal capital outlays and comparing spending projections with needs. In its 1985 supplement, OMB reviewed major needs studies in individual functional areas, and made adjustments to the needs projections to take into account methodological factors that, in OMB's view, exaggerated the estimates.

OMB projected that real Federal non-defense capital spending would rise in 1985, mostly reflecting expenditures from the increase in the Federal gasoline tax devoted to highways and mass transit, then recede by 1990 to the actual 1984 level. Based on the President's stated budget policies, real non-defense Federal capital spending would fall by 30 percent between 1985 and 1990.[9]

OMB concluded that, for the eleven categories of public civilian investment it studied, current Federal investment levels are "generally" sufficient to maintain a level of investment consistent with needs considered to be of national importance. These categories included major highways, bridges, airway facilities, wastewater facilities, and Federal buildings and hospitals. OMB also suggested that areas not deemed to be of national priority may require increased funding from states and localities or users, should those parties find that such investments are required.[10]

The OMB study interpreted needs as the amount of spending for which citizens are willing to pay, *once fully informed of their alternatives*. OMB argued that needs based on replacement costs exaggerate spending requirements because this method precludes other solutions such as substitution of cheaper technologies or planned obsolescence. It also asserted that the Federal government should be concerned only with funding Federal interests rather than aggregate national needs, that capital shortfalls should be determined only after subtracting user willingness to pay, and that user fees, developer charges, and other devices could be employed to a much greater extent than they are at present.

OMB's analysis suggests potential for improving the estimates of capital investment requirements to make them more useful in evaluating alternative policies.

OMB's analysis suggests that there is potential for improving the estimates of capital investment requirements to make them more useful in evaluating alternative policies. However, OMB is critical of the typical needs study, which arrives at its estimates by calculating how much it would cost to improve facilities to meet a predetermined standard (e.g., for bridges, meeting current lane width requirements). The "standard" usually refers to specified, uniform levels of condition, service (e.g., breakdowns per year), or public safety risk. This approach tends to emphasize structural improvements, rather than lower cost operational alternatives.

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[7] J. Norman Reid and Patrick J. Sullivan, "County Community Capital: The Status of Rural Infrastructure" in *Outlook '84: Proceedings of the Annual Agriculture Outlook Conference* (Washington, DC.: U.S. Department of Agriculture, 1983), pp. 733-46.

[8] Sullivan and Reid, *op. cit.*, p.5.

[9] George Peterson, et. al., *op. cit.*, p. III-3.

[10] Office of Management and Budget, "Supplement to Special Analysis D of the Federal Budget, Fiscal Year 1986" (Washington, D.C.: 1985), p.1.

These standards occasionally are mandated by law, but more often are drawn from planning custom, engineering rules of thumb, past spending levels, or, most frequently, the goal of restoring capital facilities to their original construction standard. Such standards typically are presented as reference points for calculating investment needs. In actuality, they reflect a particular point of view as to the capital or service quality that "ought" to be provided.[11]

Needs estimates can be reduced based on different preferences for the level of service or alternative ways of meeting performance specifications.

Views on these matters vary greatly; OMB has demonstrated that needs estimates can be reduced based on different preferences for the level of service or alternative ways of meeting performance specifications. This suggests that, from a public policy standpoint, it may be equally if not more important to consider the adequacy or inadequacy of a community's infrastructure based on the output, or level of service provided, as opposed to its physical condition alone. However, community opinions always will differ on appropriate levels of public services. Therefore, in the interest of seeking consensus on baseline national infrastructure needs, it may be advisable to work toward defining a "floor level" benchmark defined by engineering standards, such as one that would separate safe from unsafe facilities. A greater national understanding of needs then might be developed.

Needs Assessment Practices

This section reviews current Federal, state, and local inventory and condition assessment practices, with a view to determining what type of additional needs studies would be useful at the various levels of government, and how the evaluations conducted by Federal agencies might be improved.

Examining Federal Agency Needs Studies

Most Federal needs assessments concern *a single type of infrastructure*.[12] Some substantially predate the new interest in infrastructure condition and are intended to facilitate decision-making about specific capital grant programs. These functional assessments usually are conducted by the Federal government in response to Congressional directives. The balance are conducted by associations of infrastructure operators. Some of the national needs studies referenced in the earlier part of this chapter relied heavily on Federal functional studies to develop their own projections of capital investment requirements.

Federal functional needs assessments typically are large in scope and expensive; they also vary in a number of important ways. Table II-3 indicates the size, cost, and characteristics of six congressionally mandated needs assessments, including highways, bridges, mass transportation, dams, and wastewater and waterway systems.[13] Figures II-1, II-2 and II-3 give examples of the kind of information gathered by some of the more exhaustive Federal needs assessment practices, and ones with areas ripe for improvement. They are followed by a discussion of the opportunities for improvement shared by all the studies.

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[11] George Peterson, et. al., *op. cit.*, p. II-1.

[12] The term "needs assessments" is loosely defined here to include a range of practices from regularly conducted inventories of capital asset conditions to one-time studies of needs.

[13] Federal needs studies also have been prepared for a number of other types of infrastructure including airports and airways, Federally assisted housing and railroads, public buildings, space and communications facilities, Veterans Administration hospitals, and Indian Health Service facilities. These, however, are outside the present scope of the Council's review.

TABLE II-3
CHARACTERISTICS OF CONGRESSIONALLY MANDATED FUNCTIONAL NEEDS STUDIES

Characteristic	Highway	Bridge	Transit	Dam	Waste-Water	Water-Way
Size of Inventory	834,500 miles	574,000 bridges	70,000 vehicles 6,900 rail miles	68,000 dams	15,400 plants 19,300 sewer systems	12,000 miles 200 locks
Study cost (millions)	$3-5	$150-180	$2.2[a]	$90	$4-5.5	$7
Updated every 2 years	Yes	Yes	Yes	No	Yes	No
On-site inspection	3% sample	All	None	High risk[b]	None	All
Combined current & future needs only	Yes	No	No	No	No	No
Current needs	No	Yes	Yes	Yes[c]	Yes	Yes
Future needs	No	No[d]	Yes	No[e]	Yes	Yes
Includes maint. & repair	Yes	Some	No	Yes	Minimal	Yes
Needs definition considers impact of deficiency	Yes	No	No	Yes	Minimal	Yes
Includes Federally owned facilities	Yes	No	N/A	No	No	Yes
Includes needs not eligible for Fed. $	No	Yes	No	Yes	Minimal	N/A
Sensitivity analysis on standards	Yes	Some	No	No	No	No
Sensitivity analysis on future demand	Yes	N/A	No	N/A[e]	No	Yes

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[a] Includes $2 million for a one-time study of fixed rail [illegible].

[b] Dams where failure poses a significant life threat are inspected.

[c] Considers only safety needs. Demand for new facilities is not considered.

[d] The highway needs assessment, however, includes future bridge needs.

[e] Future needs for dam development or improvement for hydroelectric [illegible] analysis on future demand.

Source: Peterson, et al., *Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement by the Urban Institute, July [illegible] 1986.

Studies should distinguish among needs related to safety defects, structural defects, capacity shortages, upgrading old infrastructure to current standards, and current and future capacity requirements.

A comprehensive inventory and condition assessment can provide policymakers with useful information about infrastructure needs, which they can be used to inform the public about the status of public facilities. To be most useful, such a study should distinguish among needs related to safety defects, structural defects, capacity shortages, upgrading old infrastructure to current standards, and current and future capacity requirements.[14]

Such information can be used in three types of government activities:

- *management*, for more efficient selection and operation of infrastructure projects;
- *evaluation* of the nature of current problems, the effectiveness of ongoing programs, and past successes and failures; and
- *strategy development*, or consideration of long-term community needs and general policy direction and tradeoffs.

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[14] George Peterson, et al., *op. cit.*, p. IV-1.

FIGURE II-1

FEDERAL NEEDS STUDY: HIGHWAYS

The United States Department of Transportation is required by P.L. 89-139, 1965, to report to Congress every two years on the status of the nation's highways. (The report excludes local streets, which comprise roughly 55 percent of both rural and urban roadway mileage.)

Findings. The 1985 biennial highway status report provides four estimates of the average annual expenditure level needed through 2000 under the following alternative assumptions: (1) maintain all Federal-aid roadways at or above the minimum tolerable conditions, subject to the practicality of roadway widening; (2) maintain all roadways at or above tolerable conditions even if costs for land for widening will be very high; (3) maintain average 1983 roadway condition by functional class; and (4) maintain average 1983 user cost by functional class. As the table below shows, the annual cost to meet the engineering standards fully is far greater than the cost to maintain present conditions. The table also reveals the relative sensitivity of the need estimate to the projected rate of traffic growth over time.

AVERAGE ANNUAL FEDERAL-AID HIGHWAY NEEDS FROM 1983 TO 2000
BASED ON VARIOUS NEEDS CRITERIA AND TWO TRAFFIC GROWTH RATES
(billions of 1982 dollars)

Criterion	0% growth	2.74% growth
1. Maintain all roadways (unconstrained needs)	31.0	34.6
2. Maintain all roadways with no deficiencies unless widening is infeasible	25.3	27.3
3. Maintain overall conditions	16.7	18.3
4. Maintain average user costs	20.0	22.6

Source: *The Status of the Nation's Highways: Conditions and Performance* (1985), reported by George Peterson, et al., *Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement, July 1, 1986.

The discussion that follows examines Federal agencies needs studies, using the points mentioned above as a framework for analysis.

Federal highway and bridge needs studies, as shown in Table II-3, do not report current and future needs separately. In instances where functional studies do not distinguish among the various types of need (e.g., those related to safety or capacity) this failure usually is based not on a lack of data but on a choice about what to report. Unfortunately, these choices sometimes prevent the informed debate they are intended to serve. For example, the 1985 highway needs report (Figure II-1) would have offered much more insight if a zero-growth projection also had been provided to show how much investment is required simply to cope with wear. This and other related issues, including the use of rigid standards for analyzing needs, the bias toward new construction, the limited use of benefit-cost analysis, and the failure to clearly distinguish between current and future capacity requirements, are discussed below.[11]

The Issue of Standards. Many Federal agency needs assessments, including those for bridges, transit, and wastewater facilities, primarily examine deviations of system conditions from engineering standards or external goals (such as the size of flood a dam should accommodate without overflowing, or the probability of a water shortage in a severe drought). When resources are insufficient to meet all needs, this type of information is not very useful. Needs assessments rarely provide sensitivity analyses that show which standards are key determinants of the total cost and how greatly costs vary with small variations in these standards. Where sensitivity analysis has been undertaken, such as in the biennial highway needs studies, evidence suggests that estimates may vary by as much as 30 or 40 percent, depending on the particular standards selected. In short, needs studies tied to standards are shorthand approximations that omit both overall budget constraints and a weighing of project benefits against costs. To be of greater assistance to policy-makers, Federal functional needs studies must begin to explore the link between the standards upon which estimates are based and the quality of life and service levels that these prescribe for the community.

Needs studies must begin to explore the link between the standards upon which estimates are based and the quality of life and service levels that these prescribe.

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[11] The discussion that follows draws heavily on the analysis of issues presented by George Peterson, et al., op. cit.

FIGURE II-2
FEDERAL NEEDS STUDIES: BRIDGES

The Federal-Aid Highway Act of 1968 (P.L. 90-495, Sec. 26) established the National Bridge Inspection program and the Federal-Aid Highway Act of 1970 (P.L. 91-605, Sec. 204) established a companion program to fund replacement of unsafe bridges. All bridges on the Federal-aid system over 20 feet in length were to be inspected every two years by the states; *a biennial report to Congress was required.* The Surface Transportation Assistance Act of 1978 (P.L. 95-599, Secs. 124 and 202) expanded the inspection and reconstruction programs to include bridges of the Federal-aid system and over highways and railroads, and also permitted bridge rehabilitation as an alternative to replacement.

The biennial bridge report deals exclusively with current needs. In its biennial reports on national highway needs, the Department of Transportation (DOT) assesses the rate of emergence of new bridge deficiencies using a regression on the experience across general past inspection cycles. This rate is then used to project additional bridge needs through 2000.

The latest bridge inventory (December 31, 1984) identified 574,045 bridges, of which 140,808 were defined as structurally deficient, and 129,367 were found to be functionally obsolete but structurally sound. Of the bridges in the latter group, 75,152 or 63 percent were victims of bad deck geometry, generally lanes that are narrower than prescribed by present standards. Most of these require replacement only if they create serious traffic bottlenecks or have bad accident histories. It is unclear how many of the functionally obsolete bridges really require upgrading because FHWA does not collect information on accident incidence and severity as part of the bridge inventory, and does not appear to weigh traffic congestion heavily in its sufficiency ratings.

The Sixth Annual Report on the Bridge Program (1985) however, suggests that at least 51,000 of the functionally obsolete bridges may be good candidates for inexpensive traffic control devices, rather than bridge rehabilitation. Also, 147,861 bridges were or should have been load-posted, including 10,809 bridges that were not built for today's loads.

The number of deficient bridges and estimated cost to remedy the deficiencies are shown in the following table. The costs are estimated by FHWA based on average costs per square foot of bridge repair or replacement in the relevant state.

NUMBER OF DEFICIENT BRIDGES AND ESTIMATED COSTS TO REMEDY DEFICIENCIES*
(billions of 1982 dollars)

System	Bridges Eligible for Replacement or Retention (Sufficiency Rating Below 50)	Estimated Replacement Cost	Bridges Eligible for Rehabilitation (Sufficiency Rating 50-80)	Estimated Replacement Cost
Federal-aid	26,846	$ 15.8	31,990	$11.0
Off-system	120,164	16.8	57,015	3.7
Total	147,010	32.6	89,005	14.7

* FHWA assumes that all bridges with a sufficiency rating less than 50 will require replacement. This makes the estimated total replacement cost an upper bound. It would be easier to judge how pressing the "needs" are if FHWA reported the repair costs separately for structurally deficient bridges, and the incidence and repair costs of bridges by sufficiency rating (for example, less than 20, 20-39.9, 40-49.9).

Source: *Highway Bridge Replacement and Rehabilitation Program* (1985), reported in George Peterson, et. al., *Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement, July 1, 1986.

The Issue of Maintenance versus New Construction Biases. Few Federal functional needs studies evaluate the difference in costs between meeting performance requirements by maintaining and operating existing infrastructure at enhanced levels as compared with expensive new construction. This is in spite of growing evidence that some requirements, such as those for wastewater treatment, are being met through operating and maintenance improvements instead of new construction. Furthermore, few studies provide insight into how much of the cost of maintaining and operating the infrastructure could be financed by user fees.

Many needs assessments of specific types of infrastructure are designed to guide resource allocation decisions in Federal infrastructure financing programs. Therefore, they tend to exclude needs that are ineligible for Federal funding. The most problematic of these exclusions is maintenance.

FIGURE II-3

FEDERAL NEEDS STUDY WASTEWATER TREATMENT FACILITIES

The Clean Water Act of 1972 (P.L. 92-500, sec. 205 and 516) requires the Environmental Protection Agency (EPA) to report every two years on the cost of constructing all publicly owned treatment works needed to meet the goals of the Act. The estimates include both the backlog of needs for current populations and projected needs for year 2000. The information provides a basis for the Congressional appropriation of the construction grants program.

Needs are estimated for facilities used in the conveyance, storage, treatment, recycling and reclamation of municipal sewerage wastes. Also, needs are estimated for constructing new facilities as well as enlarging, upgrading, and replacing existing facilities. Maintenance and repair are specifically excluded.

Wastewater needs estimates for four categories of treatment are based on Congressionally mandated engineering standards for the level of effluent treatment to be applied. The needs estimates are sensitive to engineering standards, assumptions used in calculating needs and facility eligibility for funding. For example, when trickling filter or lagoon processes were allowed instead of more costly secondary treatment (with no change in water quality), EPA's estimates for "Category I" (secondary treatment) were reduced by 60 percent. Similarly, when recent actual experience was used to validate the engineering rules of thumb previously applied in estimating the cost of correcting combined sewer overflows, the urban cost estimates were reduced by 43 percent and the non-urban estimates by 71 percent.

The table below shows the 1984 EPA needs estimates for current and future populations. However, recent changes in Federal legislation and eligibility rules have narrowed the estimates of need by excluding Federal funding for most new facility capacity intended to serve needs developing after 1990. The table reflects that cut-off.

PUBLICLY OWNED WASTEWATER TREATMENT CONSTRUCTION NEEDS
THROUGH THE YEAR 2000
(billions of 1982 dollars)

Needs Category	For Current Population	Increment for Future Population	Total
Secondary Treatment	$ 22.5	$ 9.4	$ 31.9
Advanced Treatment	4.0	1.5	5.5
Infiltration/Inflow	2.7	0.0	2.7
Replacement/Rehab	3.1	0.0	3.1
New Collector Sewers	17.6	4.1	21.7
New Interceptor Sewers	10.5	8.4	18.9
Combined Sewer Overflow	22.7	0.0	22.7
Stormwater (1982 Estimate)	93.0	0.0	93.0
Total	$176.1	$23.4	$199.5

Over fifty percent of both current and future needs shown in the above table are based on actual facility plans as opposed to estimating equations. The estimates based on actual plans vary greatly by facility type. Between 70 and 75 percent of secondary treatment, advanced treatment and interceptor sewer needs are firmly based on facility plans. Only half of combined sewer outflow and 30 percent of new collector sewer needs are based on such well-developed plans.

Overall, EPA's needs estimates are primarily oriented to Federal funding needs, so their use for any other purpose is severely restricted.

Source: Infrastructure Needs Studies: A Critique, reported in George Peterson, et. al., a paper prepared for the National Council on Public Works Improvement by the Urban Institute, July 1, 1986.

Because maintenance practices can influence the useful life of infrastructure considerably, failure to consider them biases funding decisions. The fact that Federal and state governments bear a large share of the replacement cost, but little of the maintenance cost, reduces incentives for local operators to consider cost-effective, life-prolonging maintenance. Similarly, when operating costs are not subsidized but construction costs are, local governments have a strong incentive to choose capital-intensive solutions to infrastructure problems. Federal needs studies would be more useful to policy-makers if they provided an evaluation of construction, maintenance, and operating alternatives and the full range of resources available to satisfy future needs.

Needs studies would be more useful . . . if they provided an evaluation of construction, maintenance, and operating alternatives and resources available to satisfy future needs.

The Issue of Benefit-Cost Analysis. Ideally, needs studies should provide clear guidance about improvements that will yield benefits to society that exceed their costs. This idea is conceptually appealing, but in practice it is difficult to achieve. For example, no widely accepted estimates exist of how much people are willing to pay for small reductions in their health or safety risks. The Department of Transportation currently is experimenting with the use of benefit-cost analysis in its highway needs assessment, and is analyzing

Needs studies should provide guidance about the improvements that will yield benefits to society that exceed their costs.

the implications of several alternative concepts of need. Other than this, the principal use of benefit-cost criteria is in detailed design analyses of individual water resource projects, where the benefit-cost analysis method is prescribed by Congress.

Willingness to pay . . . may become as important a factor in future analyses of costs and benefits of capital improvements as long-standing engineering standards.

Benefit-cost analysis also is one way to address the fact that not all infrastructure deficiencies require remedies. In particular, the use of engineering performance standards in national assessments of infrastructure needs may ignore local willingness to trade a lower level of service for lower taxes. For example, a Federal Intergovernmental Task Force (1980) for the assessment of water supply needs, based on engineering standards, found about twice as much need in every category of performance as reported by water utilities themselves in an American Water Works Association survey where need was constrained by customer willingness to pay.[16] This suggests that community involvement in assessing costs and benefits may change widely held perceptions about the inherent value of alternative approaches. Indeed, willingness to pay for capital improvements may become as important a factor in future analyses of costs and benefits of capital improvements as long-standing engineering standards.

The Issue of Current versus Future Capacity Requirements. Few needs studies separate estimates based on current deficiencies from those based on projections of future demand. In fact, EPA explicitly excludes future needs from its biennial estimate. Among the assessments reviewed by the Council, only those related to highways and inland waterways included any such analysis. Furthermore, the analysis of highway use failed to account for differential growth in truck and automobile traffic or variations in urban and rural traffic growth rates. Federal functional needs estimates should be improved to clarify and distinguish current and future demand.

Despite the weakness of Federal functional needs studies, they do contain useful information. More important, improvement is possible without incurring new data collection costs. For example, with some additional special analysis, data currently collected on highways and bridges could distinguish between present deficiencies and pressing needs, and thus provide better information for the analysis of infrastructure issues. In sum, deficiencies in costly Federal studies should be examined as part of the effort to improve infrastructure policy-making.

State and Local Needs Assessment Practices

Needs assessment studies . . . evolve from one-time estimates of total needs to catalysts in an on-going state and local process.

While needs assessment studies at all levels of government have led to debate about the condition of capital infrastructure, and have increased public awareness of the importance of maintaining the public capital stock, at the state and local level they are beginning to take on an even more important role. There they are evolving from one-time estimates of total needs to catalysts in an on-going state and local process where the goal is to produce consensus about a whole range of capital repair, maintenance, and new construction priorities. This shift is a major step toward improving the management of infrastructure.

Needs studies also signal the beginning of the remedial process, triggering the debate and consensus-building activities necessary for legislative actions to take hold. For example, in 1983 the Washington Department of Community Development assessed the state's infrastructure needs, identifying a $2 billion investment shortfall. The study involved many local officials and interest groups and successfully forcused government and legislative attention on the condition of the state's infrastructure.

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[16] Jerome B. Gilbert, "Water Supply Infrastructure Needs: The Evolving Picture," (Denver: AWWA Research Foundation, March, 1986)

In the three years since the release of the report, the legislature has taken several steps to improve public works. Most noteworthy was the creation of a Public Works Trust Fund to provide low-interest loans for local public works projects. The Fund is capitalized by dedicated utility and conveyance tax revenues expected to yield approximately $20 million per year.

Similarly, the Georgia Environmental Studies Commission, established by the state legislature, conducted a needs assessment of environmental facilities and found that almost half of the statewide water and wastewater problems were concentrated in small rural communities that, alone, were unable to finance improvements through borrowing. A companion analysis prepared by the Georgia Development Authority recommended special assistance to communities unable to access credit markets. Proposals to create various credit enhancement mechanisms for the community have been unsuccessful for state constitutional reasons. However, the state Legislature has taken the initiative to appropriate $20 million for local water and wastewater facilities loans.

Table II-4 illustrates some of the legislative and other results of a handful of needs studies conducted at the state level over the past three years. Although it is difficult to trace or attribute the impact of certain results—such as raising public awareness about investment shortfalls or causing specific state policy actions—this table suggests that the needs assessment process has contributed to a wide range of remedial actions.

Needs studies undertaken at the state and local levels can determine whether the principal funding shortfall in transportation systems lies with small rural or large urban systems. In effect, needs studies at this level become useful screening devices to alert policy-makers to large investment backlogs or to the need for more investigation while steering them away from other areas where investment is not required.[17]

Needs studies become useful . . . devices to alert policy-makers about large investment backlogs or . . . steer them away from other areas where investment is not required.

As screening mechanisms, these studies can be made more useful by including cost-effectiveness considerations. This would highlight the policy significance of needs by comparing them with the resources ordinarily available to meet them. Many state and local studies simply have not gone far enough in this respect. Thus, future needs assessments may find opportunities to improve decision-making capabilities by refining this method.

Another basic methodological decision to be made in state needs assessments, as with Federal assessments, is whether to impose uniform standards regarding condition, safety, performance, and replacement cycles, or to leave such matters to local choice. The imposition of uniform standards has the advantage of intra-state comparability, but it ignores such local matters as the tax base, fiscal conditions, and histories of capital stock management. Local choice implicitly takes these factors into consideration, albeit at the cost of diminishing comparability of need across jurisdictions.[18]

The examples that follow illustrate different approaches in state and local needs studies.

A Pavement Management System for Arizona. The Arizona Department of Transportation designed a sophisticated pavement management system for scheduling maintenance and repair work on its 2,200 miles of interstate and 5,200 miles of non-interstate highway. Each system annually identifies the preferred maintenance action for each one-mile road segment (*e.g.*, seal coating or 3-inch asphalt overlays). Road segments are

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[17] George Peterson, et. al., *op. cit.*

[18] *Ibid.*, p. V-4.

TABLE II – 4
FINANCIAL RECOMMENDATIONS AND POLICY OUTCOMES
OF STATE NEEDS ASSESSMENT REPORTS

Study	Principal Recommendations/Other Outcomes	Adopted?
Washington (1983)	Create Public Work Trust Fund from current revenues	Yes
	Relax statute limiting non-voted G.O. debt	No
	Modify 106% levy lid	Yes
California (1984)	Create state infrastructure authority	No
	*Create Community Rehab Districts with revenue authority	
	*Relax rules on local revenue bond pools	
New Jersey (1984)	Transportation Trust Fund Authority	Yes
	Increase wastewater funding through revolving loan fund	Yes
	Guarantee local wastewater bonds	Yes
	Liberalize special assessment rules	Pending
	*New State Planning Commission needs assessment	
	*Pending legislation to update/clarify local authority	
Connecticut (1984)	Create state transportation fund	Yes
	Increase gas tax and vehicle fees	Yes
	Shift all existing gas and vehicle receipts to transportation fund	Yes
	Create local bridge repair financing program	Yes
	*Improved state capital budgeting process	
Oregon (1985)	Create public works grant and loan program	Yes
	Retain local sales tax option	Yes
	$.02 gas tax hike with weight/mile increment	Yes
	Relax restrictions on Tax Increment Financing use	No
	Strengthen use of user fees	No
Georgia (1985)	Create revolving loan fund	Yes
	Create state bond bank	No

Source: Peterson, et. al., *Infrastructure Needs Studies: A Critique*, a paper prepared for The National Council on Public Works Improvement by the Urban Institute July 1, 1986.

categorized by average daily traffic and regional physical factors such as elevation and rainfall. A mathematical model based on condition and historical maintenance data is used to select maintenance strategies to keep the greatest proportion of roads within acceptable conditions given the state's constrained resources. Through such analysis, the state found that the past practice of resurfacing roads with five inches of asphalt concrete did not show any significant reduction in the rate of deterioration when compared to roads resurfaced with three inches. At the same time, it was found that roads often had been allowed to deteriorate to the point where they required substantial and costly corrective measures.

The pavement management system has frequently recommended preventive measures.

This pavement management system has frequently recommended preventive measures so that roads will not be allowed to deteriorate to poor condition.[19] The notion that roads with certain identifiable characteristics are more likely than others to deteriorate during the budget year, and failure to catch them at this critical stage would prove more costly later, greatly improves the infrastructure resource allocation process. Similar pavement management systems are being established in other jurisdictions.

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[19] Harry Hatry and Bruce Steinthal. *Guide to Selecting Maintenance Strategies for Capital Facilities* (Washington, D.C.: The Urban Institute Press, 1984).

Some states, in contrast, take simpler but less effective approaches. For example, one state's needs estimates for its highway system are derived from standard repair and replacement cycles. This practice calls for reconstructing or resurfacing each mile of state roadway during an initial catch-up phase, after which every road segment is to be placed in a regular periodic resurfacing cycle. Although simple to calculate, this definition of need is insensitive to economic factors, such as traffic density and construction costs.

Computer mapping can be used to coordinate and schedule maintenance activities.

A Local Sewer Inventory and Maintenance Information System. The City of Philadelphia has developed a sewer facility maintenance management system based upon a computerized Dual Independent Map Encoding (DIME) system.[20] The system is an example of how computer mapping can be used to coordinate and schedule maintenance activities by identifying and graphically presenting data on repair needs that are located near one another. The plan consists of four information systems: inlet cleaning, inlet maintenance, drainage, and sewer maintenance. The system's geographic data base and team approach are designed to improve operational productivity and to refine capital planning and budgeting decision-making. The use of the system has been extended to water distribution to provide hydrant maintenance, and the streets department has recently decided to use the water department's DIME maps for its own maintenance activities.[21]

Needs studies are shifting their focus from defining the size of the needs gap for legislatures to fill, to . . . determining investment priorities.

These examples show that, as needs studies shift their focus from defining the size of the needs gap for legislatures to fill, to the more patient process of determining investment priorities, they may become more useful.

Toward a More Realistic Appraisal of Needs

Improving needs studies to better inform policy decisions involves refocusing them to (1) estimate the costs of upgrading capital facilities to certain standards, (2) clarify for the public the implications of failing to reach these standards, and (3) offer choices among alternative capital spending and maintenance strategies, tied to services provided by the investments. Using this framework, the term "needs" is a misnomer.[22] Various members of the community want, and may be willing to pay for, different levels of service from public facilities. The public at large has very little understanding of what it would cost to bring road facilities, say, to standard A, or what the consequences would be, in terms of future maintenance costs, safety concerns, and service levels, if facilities are not upgraded to this standard. A "contingent" needs study, which lays out choices and consequences for the quality of life related to alternative levels of service and costs, answers such questions.[23]

Several needs studies have begun to follow this approach, or have been forced into it when political reality has made it impossible to fund the original needs estimates. The Cleveland Community Capital Investment Strategy, for example[24], began by summing up the capital spending that would be required if all public authorities undertook the investments necessary to meet their planning standards. When it was found that the spending needed to reach these standards far exceeded foreseeable revenue, the standards were re-examined. Some of the standards with the greatest cost consequences were found to be excessive. For example, wastewater facilities were being planned on the assumption of 2-3 percent annual population growth in areas where population had been declining for long periods of time. In other cases, it was necessary to spell out just what was likely to happen if planning standards were not met, and what alternative levels of investment could be targeted with what consequences.

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[20] Peggy L. Cuciti and E. Sam Overman, *The Assessment of Investment Needs: A Review of Current Estimates and Approaches*, a paper prepared for the National Council on Public Works Improvement, July 1, 1986, p. 83.

[21] The example is updated by information provided by Harry Hatry of The Urban Institute, based on telephone conversations with city officials, September 1986.

[22] George Peterson, et. al., *op. cit.*, p. 11-9.

[23] *Ibid.*

[24] *Ibid.*

As part of the original Community Capital Investment Strategy, a group of public and private leaders weighed capital investment priorities. The group decided to increase community capital revenues (including dedicating a portion of a municipal income tax increase to capital purposes) to fund some of the needs uncovered by the study, but it also decided to accept lower standards of service and reduced levels of maintenance in other areas to avoid even greater budget costs.

Concluding Comment

Public works needs studies have been a prominent factor in recent decision-making about physical infrastructure systems. Studies undertaken since the 1970s represented the first attempt to define and categorize infrastructure needs. However, consistent with Congressional perception, the Council believes that the criteria and procedures used to assess public works requirements must be reevaluated. A number of issues are involved in this process, including consideration of the concept of need in the context of spending priorities, the variability of need in relation to standards for infrastructure improvement, the existence and effect of new construction biases, the impact of benefit-cost analysis on the definition of need, and the question of whether need should be defined in terms of current or future capacity requirements.

The Council intends to work . . . to produce more useful information for infrastructure policy-makers.

The Council intends to work with representatives of Federal, state and local government and other experts to explore the extent to which needs assessment practices—at all levels of government—can be refined to produce more useful information for infrastructure policymakers. For example, the Council will consider broad guidelines on the future organization of Federal sectoral needs studies to guide the large Federal investment in such studies. While recognizing the inherent difficulty of achieving uniform national standards for infrastructure services, the Council will attempt to seek consensus on appropriate standards for such assessments.

Chapter III Decision-Making About Infrastructure

Although the American public and the economy depend on a reliable and well-integrated infrastructure system, decisions about public facilities are made by many independent participants working in a complex and constantly changing political environment. This chapter first examines some recent shifts in responsibilities among various levels of government and the private sector and their implications for the future of the nation's infrastructure. The chapter then explores a broad range of possibilities for improving decision-making at both the policy and management levels.

The Public Sector and Public Works

Local governments always have had primary responsibility for streets, airports, sewers, water systems, storm drainage, courts, jails, and other public buildings serving local needs. Occasionally, water systems, certain schools, some solid waste functions, and some health and social service facilities are provided by private entities, in place of or in addition to local government facilities.

Decisions about public facilities are made by many independent participants working in a complex and constantly changing political environment.

States typically are responsible for intercity highways, some court, prison, and higher education facilities, and major parks. They also establish the prerogatives and responsibilities of local governments and their financing arrangements, determine home rule authority, and supply financial and other assistance to localities for a variety of purposes including public works.

The Federal government, by virtue of its constitutional responsibilities for national defense, interstate commerce, and mail, and its historical interest in Western land development, also has supported certain kinds of public works. The Federal interest traditionally has been limited to transportation facilities nationwide, and to water and power development (largely in the West and in the Tennessee Valley). However, this interest has been neither exclusive nor constant.

The transportation field illustrates how Federal, state, local, and private responsibilities often mingle in the public works field. The Federal government built some postal roads along the Eastern Seaboard in the 1700s to serve areas otherwise inaccessible. However, despite ambitious Federal road planning and sporadic funding in the early 1800s, most public roads were built by counties and townships or by private turnpike companies until the beginning of the twentieth century. State aid for highways began in the 1890s and established the basis for the Federal aid that started in 1916. Federal highway grants have been made available to the states since then on a matching basis; this form of assistance was expanded significantly by the Federal-Aid Highway Act of 1956 which added the 41,000 mile National System of Interstate and Defense Highways (with its 90 percent Federal funding) to the extensive primary, secondary, and urban systems. These Federal programs have continued to evolve, and they remain strong today.

Federal, state, local, and private interests often mingle in the public works field.

Canals and inland waterways originally were built primarily by private interests, with substantial state and local financial support. In the late 1800s, the Federal government assumed responsibility for dredging improvements at coastal and inland river ports, allowing state and local governments and the private sector to concentrate on related terminal and port facilities.

Federal support for railroads took the form of substantial land grants to private railroad companies in the second half of the 1800s, while state and local governments provided tax exemptions, credit assistance, and some land grants of their own. Later the Federal role became primarily regulatory. Most remaining passenger service today (the Amtrak system) is a Federal function, while freight rail service remains largely private.[1] A few freight lines that would have been abandoned by private railroads in the 1970s when Federal deregulation occurred, were acquired by state and local communities (frequently with the aid of Federal grants) and are now maintained by the public sector.

Federal grants to state and local units for airports and urban mass transportation were added to the list of Federal transportation assistance programs after World War II.

By the middle of the 1970s, the Federal government had become a major participant in . . . most types of public works.

Beyond the transportation field and the Federal government's own facilities, the Federal role in the other types of state and local infrastructure remained very limited until the Great Depression.[2] At that time, Federal public works spending was accelerated through both direct Federal projects and assistance to states and localities; these programs were administered by the Public Works Administration and through the Works Progress Administration. (Similar counter-cyclical public works programs have been tried several more times, most notably in the mid 1960s and again in the late 1970s—with widely disputed results.) The 1950s saw the beginning of Federal urban renewal and pollution control grants, followed in the 1960s and 1970s by a variety of new public works programs in fields such as solid waste disposal, drinking water, economic development, and rural development facilities as well as significant expansion of existing programs. By the middle of the 1970s, the Federal government had become a major participant with state and local governments in the construction and reconstruction of most types of public works, and even was beginning to assume financial responsibility for maintenance of certain types of facilities (such as state highway resurfacing). As Federal construction grants rose, a larger share of state and local public works funds were applied to operations and maintenance needs.

After 1978, . . . Federal grants to state and local governments began to decline.

After 1978, competition for funds within the Federal budget became more intense. Federal grants to state and local governments began to decline both as a proportion of the Federal budget and in their constant dollar buying power. This decline has accelerated in the past few years with the emergence of deficit reduction and national security as dominant national priorities. Concurrently, the relatively low level of assistance provided by the states has not grown to compensate for declining Federal grants.

Changing Perceptions of the Federal Role

Whether Federal aid should continue to decline is still the focus of vigorous debate.

Whether Federal aid (and the Federal role in other areas, such as research and technical assistance) should continue to decline is still the focus of vigorous debate in Congress and elsewhere. Nevertheless, enough change already has occurred to begin altering perceptions of the Federal role.

Developments concerning the Federal highway program and pollution control efforts illustrate this shift.

A Federal Highway Turnback Proposal. In 1982, the National Governors' Association (NGA) supported the 5-cent increase in the existing 4-cent Federal gasoline tax and an expanded Federal-aid highway program. However, the highway program has distributed less money than authorized by Congress because of obligation limits imposed later; the distribution shortfall for fiscal 1986 is about $2.0 billion. As a result, some governors have concluded that they could strengthen their state highway programs by taking program control—and the entire 9-cent gas tax—back from Washington.

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[1] The Federal government is attempting to sell the Conrail system in the Northeast that it has been rehabilitating from bankruptcy in recent years.

[2] Land grants for schools and colleges were the main exceptions. Some of these even pre-dated the present Constitution, but until the land grant college program began in 1862, few conditions were attached to these grants. Even then, the number of grants and the conditions attached to them grew very slowly.

An NGA analysis claims that if the states re-enacted the 9-cent tax themselves (as a committee of NGA has recommended), the amount they collected, combined with continuing apportionments from the Federal program (funded by the Federal diesel fuel tax and some other excise taxes that contribute to the Highway Trust Fund), would put the resulting revenues to work more reliably in most states, without being siphoned off for Federal deficit reduction. The NGA committee proposed that the remaining Federal program include such things as research and development, safety grants, and a guarantee that all states enacting the 9-cent tax themselves would receive at least as much as under the prior program.

This proposal had support from about half of the governors voting on it at the 1986 winter meeting of NGA. Although the issue is controversial and has not been accepted by the majority of NGA's membership, its prominence in the media during that meeting and in subsequent discussions is a noteworthy signal of concern about the Federal role.

Pollution Control. A recent analysis of environmental policy issues, published by The Urban Institute, observes that the amount of detailed regulatory responsibility assigned to EPA in its major statutes, compared to EPA's declining capacity, creates the perception that Federal environmental policies simply cannot work.[3]

The wastewater treatment program illustrates this growing mismatch between Federal standards and Federal funds available to help state and local governments meet them. The Federal Pollution Control Act of 1972 mandated a single minimum uniform national treatment standard for wastewater facilities without regard to conditions in the receiving body of water. At the same time, the Federal government provided billions of dollars in construction grants to state and local governments to help meet this rigid standard.

Currently, some Members of Congress and the Administration are moving to phase out construction grants in the next few years, even though substantial needs mandated by Federal standards remain unfunded. A proposal now being considered in Congress would phase out the construction grants program by 1990 and replace it with Federal seed money to capitalize state-administered revolving loan funds. The seed money would then be phased out by 1994. This proposal would shift the costs of complying with Federal treatment standards from the Federal government to state and local governments. Meanwhile, EPA has stiffened its enforcement of wastewater treatment laws through the National Pollution Discharge Elimination Standards permit program.

As local costs rise, and as local pollution problems are better understood, many state and local officials complain that the technology-based Federal mandate is both inappropriate and too expensive, and that they could find better solutions to local wastewater and related pollution control problems on their own.

Many state and local officials complain that technology-based Federal mandates are both inappropriate and too expensive.

Criteria and Proposals for Readjusting Federal, State, and Local Roles

The publication of the Kestnbaum Report in 1955[4] rekindled a vigorous debate on the proper roles of various levels of government. The Kestnbaum Commission recommended a limited national role in which the Federal government would undertake a program only if (l) Federal financing was essential (2) nationwide scope or national technical resources were required, (3) national uniformity was needed, (4) states would act injuriously toward one another in the absence of Federal intervention, or (5) states would fail to act on their own.

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[3] Crandall and Portney, "Environmental Policy," *Natural Resources and the Environment: The Reagan Approach* (Washington, D.C.: The Urban Institute Press, 1984), p. 81.

[4] The Commission on Intergovernmental Relations, *A Report to the President for Transmittal to the Congress* (Washington, D.C.: U.S. Government Printing Office, June 1955). This report was requested by President Eisenhower in reaction to the vastly increased role of the Federal government that had resulted from the Depression and War years.

Many other study groups have developed their own criteria since then and offered various proposals for reallocating program and financial responsibilities among the levels of government. For example, more than thirty years after the Kestnbaum Report appeared, the Committee on Federalism and National Purpose, co-chaired by United States Senator Daniel J. Evans (former Governor of the State of Washington) and Charles S. Robb (former Governor of Virginia) used very similar criteria to develop its own reallocation recommendations.[5] In the view of the Evans-Robb committee, the Federal government should have principal responsibility when nationwide uniformity of policy, finance, or administration is important or when it is necessary to raise revenues from the nation as a whole. In turn, states and localities should take full responsibility when diversity of policy, finance, or administration is important or where experimentation by officials responsible to local electorates and knowledgeable about local conditions are key to meeting public needs.

Infrastructure programs are cited frequently for Federal reductions.

Ongoing organizations like the Advisory Commission on Intergovernmental Relations (ACIR) and the Congressional Budget Office (CBO) from time to time have developed more technically-oriented criteria, using concepts such as economic efficiency, fiscal capacity and equity, political accountability, and benefit-cost analysis. In its 1986 report concerning turnbacks of Federal responsibilities and resources[6], ACIR urged that return of program responsibilities to state and local government be determined by:

- the extent of decentralization achieved (which is related to fiscal and political accountability);
- the simplicity of any resulting plan (in terms of encouraging ease and quality of implementation);
- certainty of funding;
- future revenue adequacy (given hard-pressed budgets at all levels of government); and
- effects on fiscal discipline (given similar pressures to avoid tax increases).

All of the above organizations have recommended reductions in certain Federal roles, and sometimes offsetting increases in some of its other roles (such as Medicare). Infrastructure programs are cited frequently for Federal reductions because their benefits are seen as largely local, and they can be financed, at least in part, through state and local user fees or with private sector participation.

State and local governments are perhaps in better shape to assume increased responsibilities for infrastructure finance than ever before.

State and Local Potential for Increased Roles

State and local governments are perhaps in better shape to assume increased responsibilities for infrastructure finance than ever before. The states, for example, have strengthened their staffs and management systems, have assumed a much more aggressive attitude toward economic development, now administer a greater variety of programs (due in part to their experience with Federal aid programs), have better equipped legislatures, and administer more productive revenue systems (despite current difficulties in the oil-producing and farm states).[7]

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[5] Committee on Federalism and National Purpose, *To Form a More Perfect Union* (Washington, DC: National Conference on Social Welfare, 1985). The Report recommended that current Federal responsibilities in a number of infrastructure programs be returned to state and local governments, and that the Federal government should assume greater policy and financial responsibility for major shared welfare programs.

[6] Advisory Commission on Intergovernmental Relations, *Devolving Federal Program Responsibilities and Revenue Sources to State and Local Governments*, Report A-104 (Washington, D.C.: U.S. Government Printing Office, March 1986), p. 73.

Many local governments also are stronger than in the past. By and large, they are more likely to be professionally staffed and managed, to have diversified revenue systems and effective business development programs, and to be active members of their various national organizations, which offer a wide range of technical support services.[8]

Nevertheless, relationships still are strained between some states and their localities.[9] The perceived lack of state responsiveness to urban needs was a significant factor in the development of direct Federal-local grant arrangements in the 1960s and 1970s. Any significant realignment of Federal programs now is likely to increase the need for communication and cooperation between states and local governments. In particular, distressed communities, with inadequate or declining tax bases and more than usual demands on their resources in comparison to their capacities, may need special attention at the state level.[10]

Any significant realignment of Federal programs is likely to increase the need for communication . . . between states and local governments.

Increasing Private Sector Roles in Providing Public Works

Several factors are beginning to focus greater public attention on ways to expand roles for the private sector in providing public works:

- Federal aid for capital investment has declined significantly (for all categories except transportation);
- taxpayer resistance or property tax limitations have caused state and local officials to refrain from compensating for many Federal reductions;
- rapid growth in some areas and aging facilities in other offices have increased demand for expanded or renovated public facilities; and
- user fees, which assess the costs of facilities against the primary users or beneficiaries, are more widely accepted in financing public services.

In areas of especially rapid growth, developers often are willing to supply much of the needed public works themselves, or to contribute funds to accelerate public provision of them. Likewise, some regions and localities rely on formal systems of development impact fees to assure adequate public facilities.

In areas of rapid growth, developers often are willing to supply much of the needed public works themselves.

Another public-private effort to cope with growth involves arrangements in which major private employers agree or are required to reduce demands on public facilities. One of the best known examples is Pleasanton, California, which enacted a city ordinance in 1984 requiring employers of 50 or more workers to cut by nearly half the number of vehicles their employees use each day during peak traffic hours. Means to achieve this goal include transit subsidies, carpooling, vanpooling, expanded flex-time, and bicyle accommodations, and other measures that the employers may devise. The ordinance was drafted in cooperation with developers and employers in the city, and is administered with the help of a committee representing the regulated parties. Business support was based on a recognition that something needed to be done about traffic congestion, and that further development might have to be significantly slowed or stopped unless some remedy could be found.[11]

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[7] Advisory Commission on Intergovernmental Relations, *Devolving Federal Program Responsibilities and Revenue Sources to State and Local Governments*, Report A-104 (Washington, DC: U.S. Government Printing Office, March 1986), p. 73.

[8] Advisory Commission on Intergovernmental Relations, *State and Local Roles in the Federal System*, Report A-88 (Washington, DC: U.S. Government Printing Office, 1982).

[9] Advisory Commission on Intergovernmental Relations, *The Condition of American Federalism*, Report M-144 (Washington, DC: U.S. Government Printing Office, 1986).

[10] Advisory Commission on Intergovernmental Relations, *The States and Distressed Communities: Final Report*, Report A-101 (Washington, DC: U.S. Government Printing Office, 1985).

With respect to infrastructure maintenance and operation, developers who build public works facilities as a condition of development permits generally turn them over to the public. However, roads, parking lots, and open spaces in large-scale developments and condominium projects sometimes are turned over, instead, to associations of owners. Some individuals have advanced the idea of selling or leasing sections of public highways to private interests as a means of transferring maintenance responsibilities to the private sector.[12] This idea has its roots in the fairly common practice of contracting for private operation of other public facilities such as airports, recreational facilities, landfills, and transit systems.

These examples of private involvement illustrate some of the possible means of tapping the financial resources of direct beneficiaries of development—the developers and the buyers of their products. A more traditional way of assessing beneficiaries for the costs of facilities is to establish a public benefit assessment district or a governmental special district or revenue authority. Assessment districts are administered by a general purpose local government, while special districts and authorities are established as separate units of government usually responsible for only a single function or a narrow range of related functions such as water supply and sewerage. Currently, there is substantial renewed interest in toll road authorities.

Those who promote a larger private role in meeting infrastructure needs cite such advantages as market competition, increased flexibility, lower fixed costs, pricing that encourages efficient use of services, and improved responsiveness to changing conditions. Those who advocate public solutions stress the advantages of greater political accountability and the broader availability of services, regardless of ability to pay.

Public-private partnerships may provide a means of benefiting from the advantages of both sectors under favorable economic conditions. For example, contracting out certain municipal services to the private sector can combine the advantages of public accountability with those of competitive market prices.

Public-private partnerships appear to be most attractive in economically robust areas.

Public-private partnerships appear to be most attractive in economically robust areas where there is sufficient private interest in expanding public works capacity to allow development permits to be issued, and where adequate streams of revenue are available from development to foot the bill. Current experience in places like Texas, Florida, and California—where such activities are common—indicates that less than 10 percent of public works needs can be met in this manner.[13]

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[11] David Curry and Karen Fraser-Middleton, "Pleasanton TSM Ordinance: A New Approach to Traffic Mitigation", a paper presented at the 64th Annual Meeting of the Transportation Research Board, January 14-18, 1985.

[12] Fred Moavenzadeh, "Private Highways: A Proposal to Help Resolve the Highways Infrastructure Crisis" (Cambridge, MA: Center for Transportation Studies, January 12, 1986), unpublished.

[13] This figure emerged as a consensus of experts attending the National Conference on Highway Finance sponsored by the American Association of State Highway and Transportation Officials in Smuggler's Notch, Vermont on August 17-18, 1986.

Increasing focus on the benefit principle for financing public works opens up thorny questions about how to determine precisely who benefits, who pays, and how much. Also, greater attention must be paid to the impact on low-income consumers as well as the treatment of various beneficiaries by related or neighboring jurisdictions.

Management and Decision-Making Practices

Whether or not society chooses to spend more on public works at any particular level of government, available funds should be spent with greater timeliness, efficiency, equity, and accountability. A strong consensus emerged from several of the papers prepared for the Council on the need to improve management and decision-making practices in line with these four criteria. This section examines these criteria and some opportunities to fulfill them that currently exist in the public works field.

Criteria for Improving Management and Decision-Making Practices

1. *Timeliness.* Many major public works projects are delayed for decades by lengthy planning and decision-making processes. Major dams, port dredging projects, and highway segments, especially, are likely to experience such delays. Meanwhile, the benefits of these lagging projects are not realized, and the cost of building them escalates. Of course, not all proposed public works meet essential economic and environmental tests, but speedier decisions on whether or not to build would allow society to realize the benefits of deserving projects more quickly.

Speedier decisions . . . would allow society to realize the benefits of deserving projects more quickly.

Accelerated decision-making also is needed with regard to the maintenance of existing facilities. Deferred maintenance may result in greater cost at a later time for major reconstruction or replacement, plus a lower level of services and safety.

Timeliness is also important to developers and to the achievement of community economic development goals. For developers, delays increase carrying costs and may undermine the economic feasibility of some projects. For communities undue delays slow the benefits that accrue from the creation of jobs and housing opportunities.

Public works dollars can be allocated more efficiently [with] appropriate management tools, materials, and technologies.

2. *Efficiency.* Public works dollars are limited. They can be allocated more efficiently only if public agencies find and use the most appropriate management tools, materials, and technologies to determine infrastructure needs and accomplish construction and repair work.

3. *Equity.* Spending more fairly is a matter of determining who benefits and who should pay. Although many political judgments play a part in these determinations, thorough economic studies may help decision-makers become more aware of the relative benefits that flow to users, special segments of the present population, the general public, and future generations.

4. *Accountability.* Increasing the accountability of public works decisions requires that elected officials and informed citizens be an integral part of infrastructure planning and implementation.

. . . elected officials and informed citizens are an integral part of infrastructure planning and implementation.

Techniques for Improving Public Works Management and Decision-Making Practices

In reviewing the background papers it commissioned, the Council noted that the management, planning, public works, public finance, accounting, scientific, engineering, and knowledge-sharing professions all see a major need for improved political leadership and management practices in the public works field.

Five key elements were identified in these papers: (1) the need for improved decision-making and management tools, with special reference to capital improvement planning, (2) the need to support public works managers and staffs; (3) the constant need to review and revise standards and regulations that may hinder public works goals or unnecessarily increase costs; (4) the need to stimulate public works innovations and induce their widespread use; and (5) the need to improve contracting procedures. Techniques currently available to address these matters are described below.

Improving Decision-Making Techniques. At least five management improvement techniques should be evaluated for more widespread use.

- A broad range of emerging data systems may offer opportunities for improving public works needs studies, peak load reallocation systems, capital improvement programs, programmed maintenance systems, and other decision support systems. Their use also may help to identify low cost alternatives that would increase the productivity of infrastructure facilities and systems.
- Intergovernmental coordination techniques may help span the boundaries that tend to segregate the public works activities of neighboring or related jurisdictions.
- Dispute prevention and resolution techniques increasingly may help to (1) resolve environmental protection issues, (2) site locally unwanted land uses (LULUs) like sewage treatment plants and land fills, (3) increase labor productivity, and (4) negotiate public-private agreements on financial and operating issues.
- Innovative planning processes may help communities establish strategic development goals (including economic growth and housing cost reduction), formulate ordinances to coordinate growth with the provision of public facilities, increase developer participation in financing needed public works, and implement capital improvement programs that can leverage other forms of cost-effective development.
- Effective capital improvement programs (CIP) and capital budgeting processes may help to strengthen local decision-making and fiscal management of public works programs.

Innovative planning . . . effective capital improvement programs and capital budgeting processes may help to strengthen local decision-making and fiscal management of public works programs.

Because of their wide use and relative importance, CIPs and capital budgeting processes deserve further elaboration here.[14] The CIP technique has been developed over many decades to help plan and budget for infrastructure investments by states and localities. It is used most extensively at the local level, where typically it encompasses the full range of physical facilities for which the local jurisdiction (city, county, township, school district, or special district) has responsibility. For cities and counties, CIPs frequently include a wide range of roads, water and sewer systems, parks, public buildings, and other facilities, including those being funded with Federal and state aid. Usually, chief executive officers and the executive agencies under their control prepare the CIP on an annual basis for review and adoption by the local governing body. At its best, the local CIP serves as a means of increasing public attention to and government accountability for community and economic development policies and actions.

At the state level, CIPs tend to focus on a more limited range of facilities, sometimes only public buildings. They are used at this level more to coordinate financial initiatives than as comprehensive guides to state development. Plans for such facilities as transportation or natural resources facilities often are outside the purview of the CIP that the governor sends to the legislature for budget approval. Citizen participation is more limited than at the local level, and often it centers on attempts to influence the governor and legislature late in the funding process, rather than on involvement at earlier program planning stages.

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[14] Much of this discussion of capital improvement planning, programming, and budgeting is drawn from Hatry, Neary and Allen, "The Capital Investment Maintenance Decision Process in the Public Sector," a paper prepared for the National Council on Public Works Improvement by The Urban Institute, July 1, 1986.

The Federal government has no CIP in the sense in which the term is used at the state and local levels, nor does it have a separate capital funding process or borrowing plan. The Budget of the United States Government lumps most capital and operating expenses together; it is shaped through several separate appropriations bills, each of which funds a group of agencies. These bills determine direct capital expenditures for Federal buildings, dams, hydroelectric plants, national parks and forests, and military installations, as well as Federal aid to states, local governments, and others for facilities such as highways, airports, mass transit, and pollution control.

The Federal capital spending analysis prepared by the Office of Management and Budget (Special Analysis D) is compiled after agency officials make their budget decisions and is not designed to be part of the decision-making process.[15] However, as a result of Congressional action, additional information about capital needs recently has been added to this analysis[16], and the issue of whether the Federal government could benefit from a capital budget is debated from time to time.[17] Some individual Federal agencies have highly developed capital planning and budgeting procedures within their own spheres of responsibility.

Regional planning organizations and councils of governments frequently prepare areawide plans for land development and related public facilities—especially those built with Federal assistance. Some of these bodies also compile and analyze local capital improvement programs within their region. Although these regional organizations seldom have a direct role in making capital funding decisions, they do review and comment upon most capital projects involving Federal funding (both direct spending and Federal aid). They also may influence other projects through collaborative relationships among elected officials of neighboring or related jurisdictions within the region.

Typically, a CIP identifies a five- or six-year list of capital improvements needed to keep infrastructure systems in good order and to meet new demands. The capital budget funds the first year of the program, and those projects that appear in the remainder of the CIP become candidates for funding in future years.

Research on capital planning and budgeting has . . . identified opportunities for improvement.

Research on the use of local and state capital planning and budgeting documents has revealed questions about their effectiveness and identified opportunities for improvement[18]. To be effective, CIPs need to:

- articulate the extent of capital repairs and operational improvements, as well as new construction, that a jurisdiction determines to be needed;
- identify the jurisdiction's most pressing problems, establish priorities based on life-cycle economic analyses of facilities, and clearly show the consequences of funding one project over another as well as of deferring maintenance;
- integrate the analysis of capital projects being financed by the general fund with those financed by (1) separate enterprise funds within the same jurisdiction, (2) overlapping districts, and, (3) neighboring or related jurisdictions (when relevant); and
- thoroughly inform elected officials and the public about the choices available to them.

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[15] U.S. General Accounting Office, *Federal Capital Budgeting: A Collection of Haphazard Practices*, February 26, 1981, p. 12. This study also discusses other deficiencies of Special Analysis D.

[16] The Federal Capital Investment Program Information Act of 1984, Title II of P.L. 98-501.

[17] See, for example, U.S. General Accounting Office, *Pros and Cons of a Separate Capital Budget for the Federal Government*, September 22, 1983, and Stockman, "Statement on Capital Budgeting and Public Infrastructure Policy", Office of Management and Budget before the Subcommittee on Economic Development of the U.S. House of Representatives, May 3, 1983. The Office of Management and Budget and the General Accounting Office each currently has a major study of this issue underway. See also Advisory Commission on Intergovernmental Relations, *Strengthening the Federal Revenue System: Implications for State and Local Taxing and Borrowing* (Washington, D.C.: U.S. Government Printing Office, 1984), p.5.

[18] Hatry, Neavy and Allen, *op. cit.*

For CIPs to achieve these objectives, there needs to be information about the fixed assets of public jurisdictions. At present, most jurisdictions are required only to carry such assets on the books at their original cost, without regard to current value, replacement cost, present condition, maintenance needs, or the financial consequences of deferring maintenance.

The priority-setting process has been enhanced in many places by citizen surveys.

The priority-setting process has been enhanced in many places (including Colorado Springs, Portland, Oregon, and Tacoma, Washington) by citizen surveys that help determine perceptions of facility conditions, improvement needs, and willingness to pay for improvements. In addition, some cities (Milwaukee, Wisconsin, for example) use technical guides such as pavement resurfacing schedules to coordinate utility construction with road repairs. Other jurisdictions adhere closely to master plans as a means of moderating the powerful political forces that naturally influence rankings of capital projects.

Small and rural jurisdictions face a different set of challenges . . .

Small and rural jurisdictions face a different set of challenges than larger jurisdictions. With limited staff and other resources, they are often unable to maintain detailed information on the condition of their facilities or to prepare capital improvement plans or budgets. While such communities may have very limited and uncomplicated assets, some form of capital planning and budgeting can be valuable in managing sudden growth demands or averting system failures. State agencies and regional councils can be important sources of technical assistance and support in these cases.

Supporting Public Works Managers and Staffs. Public works managers and staffs are a key resource in meeting infrastructure needs. However, they face important challenges.

Serious attention should be given to the need to replenish the ranks of public works personnel and assure that they are adequately prepared to perform effectively in the public policy environment of the future.

Among these challenges is the increasing perception that public works are a means of achieving a variety of environmental and economic objectives over and above the direct benefits of individual facilities. Public works managers must not only cope with a wide spectrum of engineering and technological issues and advanced management information systems, but also with creative finance, intergovernmental relations, the arts of negotiation and conflict resolution, a significant shift from construction to long-term maintenance and management of assets, and much more.

Another challenge appears to be the likely diminution in the ranks of professional public works managers. For example, approximately one-third of the professional engineers in state and county transportation departments (the most senior professionals) are expected to retire within a decade.[19] At the same time, the supply of civil engineers is projected to be declining.

The Council believes that serious attention should be given to the need to replenish the ranks of public works personnel and assure that they are adequately prepared to perform effectively in the public policy environment of the future. Needs and opportunities for transportation professionals in the decade ahead have been thoroughly analyzed in a recent study that may offer an appropriate model to guide other public works disciplines in evaluating their future.[20]

Federal and state regulations greatly influence capital investment and maintenance decisions.

Revising Regulations and Standards. Federal and state regulations greatly influence capital investment and maintenance decisions. Intergovernmental aid for infrastructure generally is tethered to standards that sometimes impose, from the recipient's viewpoint, needless added costs. For example, in examining Federally mandated standards in the areas of bridge and road rehabilitation and secondary wastewater treatment, The Urban Institute reports the following concerns expressed by grant recipients:

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[19] Transportation Research Board, *Transportation Professionals: Future Needs and Opportunities* (Washington, DC: National Research Council, 1985), p. 1.

[20] *Ibid.*

- the cost resulting from certain standards is high;
- the effectiveness of certain standards is questionable, since stated service goals frequently have not been achieved;
- standards often are too rigid and do not allow for local flexibility;
- the short time frames for compliance with new standards are very costly to state and local government;
- mandates often prescribe not what needs to be done, but *how* it must be done, a practice that adds to costs and administrative burdens;
- Federal standards often are developed based on incomplete or inadequate information.[21]

In 1982, the Federal government authorized states to develop their own standards for . . . existing Federal-aid highways . . . this experiment encouraged the improvement of more miles of road than if standards had not been changed.

The high cost and inflexibility of Federal regulations affecting infrastructure is illustrated in the industrial waste pretreatment program of the Metropolitan Sanitary District (MSD) of Greater Chicago. The city viewed its industrial waste treatment program, which was regarded as a model when first put in place, as sufficient to meet its own rigorous wastewater standards. MSD estimated that the added costs of complying with Federal regulations would be substantial without yielding commensurate improvements in water quality or protection of capital equipment. In MSD's view, the increased expense of satisfying Federal regulations would not be cost-effective. Nevertheless, because the Federal program did not allow publicly owned treatment works the flexibility to meet effluent limits in their own way, MSD was compelled to retool its program to meet Federal regulations and pay the higher initial capital costs and increased operating costs on a continuing basis.[22]

In 1982, the Federal government authorized states to develop their own standards for designing, rehabilitating, and repairing existing Federal-aid highways. According to the Federal Highway Administration, this experiment has encouraged the improvement of more miles of road than if standards had not been changed.[23] Nevertheless, debate continues over whether the reconstructed roads are as safe as they should be. Unfortunately, little information is available on the safety impact of state-revised standards, and the Council is not aware of any similar current experiments with other Federal infrastructure program standards.

A periodic review procedure for Federal and state . . . standards and other program requirements

A periodic review procedure for Federal and state maintenance and construction standards and other program requirements (including those designed to achieve social and economic goals) could provide useful information to policy makers in Congress and state capitals.[24] This review should consider the overall Federal financial incentives that affect state and local spending priorities for the various types of public works, as well as public safety and the balance between construction, maintenance and operational improvements.[25]

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[21] Hatry, Neary and Allen, *op. cit.*, p. 76.

[22] This example was identified for the Council by The Urban Institute and confirmed by telephone conversation with Mr. Cecil Lue-Hing of the Metropolitan Sanitary District.

[23] Hatry, Neary, and Allen, *op. cit.*, p. 77.

[24] This is a complex topic that already has received considerable attention, but little or no consensus. See, for example: Advisory Commission on Intergovernmental Relations, *Regulatory Federalism: Policy, Process, Impact and Reform* (Washington, DC: U.S. Government Printing Office, 1984). See also a current listing of Federal mandates requiring state legislation: Robert L. McCurley, Jr, *Federally Mandated State Legislation* (Washington, DC: National Conference of State Legislatures, June 1986).

[25] The state highway agencies, working through the American Association of State Highway and Transportation Officers, have performed such reviews for many years, and the results have proved valuable.

Encouraging Public Works Innovations. Innovation in the public works field can be accelerated by wider use of a number of well-known techniques, described below:

a. *Knowledge Sharing.* The roots of the "knowledge sharing" profession go back to the establishment of the Agricultural Extension Service well over 100 years ago. Since then, a great deal has been learned about how to demonstrate the benefits of new technologies and other innovations and how to achieve more widespread acceptance. For example, the Transportation Research Board and the Office of Technology Sharing in the U.S. Department of Transportation both provide strong evidence of the benefits of cooperation and central motivation in activities like research and development and technology transfer.

. . . an immense number of innovations are available which have great potential for improving public works and containing costs.

As several of the papers commissioned by the Council point out, an immense number of innovations are available which have great potential for improving public works and containing costs. These new ideas—many of which emerge from research universities or the private sector—range from new accounting methods and standards to new construction materials, sensors and robots that can detect public works maintenance needs more efficiently, measures for reducing demands on infrastructure, computer-aided design techniques, public works quality control techniques, and advanced decision support systems based upon computers.

One major technical resource that might be used more than in the past consists of several hundred Federal government research and development laboratories. They are required by law to make their findings available to state and local governments, as well as to the private sector, but their resources remain largely untapped. Gaining access to relevant work undertaken by them requires substantial effort, and state and local governments currently have no convenient means by which to take the required initiative.

By recognizing the potential for disputes ahead of time, programs and projects can be designed from the beginning to reduce or eliminate points of contention.

b. *Dispute Prevention and Resolution.* Another area of significant potential improvement is in the emerging professional discipline known as "dispute resolution." This field grew out of the labor negotiation experience, but in recent years, it also has provided the basis for (1) intergovernmental negotiated investment strategies and cost-sharing agreements, (2) public-private negotiations between local governments and developers for financing certain public works, and (3) negotiations between public agencies, citizen groups, and developers to settle environmental disputes over proposed new developments. Often, by recognizing the potential for disputes ahead of time, programs and projects can be designed from the beginning to reduce or eliminate points of contention and to pave the way for more rapid achievement of public works objectives. Special attention may be needed in the labor field where mounting pressures for increased productivity in public works programs are likely to cause job losses and restructuring.

The beneficial role of mediators in such negotiations has been documented in a substantial number of case studies over the past decade.[26] These lessons have potential for improving dispute prevention methods and for speeding up dispute resolution in many cases concerning both labor and environmental issues.

Infrastructure systems present the clearest case among the various functions of government for interlocal coordination.

c. *Intergovernmental Cooperation.* Infrastructure systems present the clearest case among the various functions of government for interlocal coordination. Transportation, water, and solid waste systems are essential areawide resources that must interconnect if they are to perform their functions effectively and efficiently. Regional councils have been most effective in coordinating certain transportation and pollution control functions across local jurisdictions when Federal aid and areawide planning requirements have been involved. However, with Federal interest regarding regional cooperation on the wane, responsibility for this concern appears to be shifting more directly to the state and local levels. It remains to be seen what new equilibrium in areawide planning and coordination processes will evolve from these continuing shifts.

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[26] Gail Bingham, *Resolving Environmental Disputes: A Decade of Experience* (Washington, DC: The Conservation Foundation, 1986).

Currently, about half the states have established state-local relations bodies similar to the national Advisory Commission on Intergovernmental Relations. A few states also have established boundary commissions to oversee annexations, the establishment or expansion of new local governments or special districts, and other local boundary changes. In a related vein, the State of Oregon has established a tax monitoring commission for the Portland metropolitan area to monitor overall tax burdens resulting from rate levies by overlapping jurisdictions.

Enhancing Private Contracting. Currently, public works programs rely heavily on outside contractors for construction services and many are exploring, if not actually using, private contractors for maintenance and operating functions. Such contracts provide needed specialized services, while avoiding the expansion of public payrolls and capturing the cost-reducing benefits of private competition.

Nevertheless, government purchasing procedures at all levels of government are complex—whether based upon competitive bidding, competition on the basis of professional qualifications followed by negotiation of a fair and reasonable price, sole source negotiations, or other principles. They pose numerous requirements that are difficult and time consuming to supervise and that are subject to the risk of irregularities. Costs are increased by these complexities, and scandals occur from time to time.

Because contracting with the private sector will continue to be an important feature of infrastructure development and management, it may be advantageous to reconsider bidding and negotiating procedures, regulations affecting state and local contracting practices, programs for training of governmental purchasing agents, and audit procedures in the public works field. In addition, cost overruns, unnecessary delays, ethical and legal irregularities, and other difficulties can be avoided through well developed and monitored contracting programs.

Improving Public Works Management and Decision-Making Practices

As discussed in this chapter, the relative involvement of Federal, state and local governments in planning and financing infrastructure improvements has shifted. The trend requires reevaluation of the decision-making processes and of the responsibilities of each level of government. Many state and local governments have, in fact, responded to these changes, and involvement of the private sector has increased in areas traditionally viewed as governmental in nature.

The Council will identify . . . programs for improving contracting procedures with the private sector.

In conjunction with the shifting roles of governments, additional attention has focused on the need for improved political leadership and management practices in the public works field. In Reports II and III, the Council will try to identify special opportunities or significant programs among the following areas:

- implications of shifting roles among Federal, state, and local governments;
- a wide range of data systems for supporting decision-making—with special reference to capital improvement programming and budgeting, and to the relative roles of elected officials and staffs in this process;
- governmental accounting practices which support informative fixed asset record-keeping and life-cycle management techniques;
- intergovernmental coordination;
- dispute prevention and resolution;
- community planning techniques, including developer participation in providing public works;
- programs for attracting and developing a strong cadre of public works personnel able to meet new challenges;
- a reevaluation of existing public works program regulations and design standards enabling cost-effective adaptations to varying conditions;
- techniques for encouraging innovation and greater quality assurance; and
- programs for improving contracting procedures with the private sector.

Chapter IV

Technology and Infrastructure Improvement

Each year, thousands of communities face critical and costly infrastructure investment decisions that have far-reaching consequences. These decisions often fall to local officials who possess limited research capacity to identify and evaluate new technologies and materials, and who have little margin for error in deploying their available financial resources. While traditional technologies may be cost-effective in many cases, the opportunity to introduce less expensive, more efficient alternaties will be lost without access to information about new techniques. For example, new materials and equipment to manage demand (*e.g.*, freeway ramp metering and water conservation) and improve maintenance (*e.g.*, *in situ* replacement of pipe linings) may offer potential major savings for governments and taxpayers—if local decision-makers are aware of their availability and use.

The emerging infrastructure renewal market . . . is sufficiently large to guarantee significant payoffs for private industry research and development.

The scope and diversity of the emerging infrastructure renewal market also may offer opportunities and incentives for new private business investment. A recent paper on transportation research needs from the Center for Construction Research and Education of the Massachusetts Institute of Technology suggests that this market ". . . is sufficiently large, dispersed and diverse to guarantee not only significant payoffs for private industry research and development, but also spinoffs to improve the construction industry's productivity in other markets as well."[1]

American firms stand to benefit equally with government units from technological advances. However, without adopting such advances, they will find it more difficult to compete for public works projects here and abroad. Foreign firms in increasing numbers already are bidding aggressively for new construction in the United States and throughout world markets.[2] American companies still are thought to hold an advantage in applied computer technology, but their competitive margin in certain new materials, sensing devices, and construction methods—such as tunnelling techniques— is being eroded by Japanese and European firms.

Potentials for Technological Innovation

The perception is widespread among industry representatives, professional engineering and trade associations, and researchers that technological innovations in the public works field have lagged well behind those in defense, medicine, and space exploration. In fact, the basic technology of public works has changed very little in the past 50 years. Nevertheless, it appears that current developments in science and engineering are capable of making significant contributions to the improvement of every major infrastructure sector in the foreseeable future.

Science and engineering are capable of making significant contributions to . . . every major infrastructure sector.

Such contributions can occur on two levels: first, research that leads to significant scientific breakthroughs may alter radically the demand for and supply of public works facilities; and second, many promising techniques and materials, which are now available, may offer substantial and immediate benefits if their potentials were more widely known and if institutional barriers to widespread use could be lowered.

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[1] Fred Moavenzadeh, "Research Needs in Transportation Facilities: Guideway Technology and Materials Research," *Transportation Research*, Vol. 19A, No. 5/6, September/November 1985, pp. 497-509.

[2] Robert A. Bennett, "Now, Japan Inc. Wears a Hard Hat," *The New York Times*, July 27, 1986.

A recent conference of experts on technological alternatives for urban infrastructure, sponsored by the Building Research Board of the National Research Council, found that engineering research could affect infrastructure supply and demand in four ways:[3]

- by combining one or more infrastructure functions, such as treating liquid wastes while still in collecting pipes, bundling various utilities together in common conduits (utilidors), or using fluid transmission pipes to transport other materials (similar to coal being transported in slurry pipelines);
- by separating functions that now are combined, such as replacing pipe linings rather than whole pipes;
- by replacing sections of infrastructure when needed, using the latest materials and processes so that whole systems will be upgraded over time; and
- by making infrastructure systems self-diagnosing through incorporation of automated sensing and control devices.

Expanded and accelerated research . . . promises to make public infrastructure less expensive and more reliable.

Expanded and accelerated research in these areas promises to make public infrastructure services less expensive and more reliable.

The Potential of Information Systems Technologies

The NRC conference also emphasized the great potential of information systems to enhance the performance, durability, flexibility, and productivity of virtually every infrastructure system.[4] The multiple benefits of this technology include:

- better management through real-time monitoring and self-diagnosis of systems;
- greater information sharing and citizen participation, including new forms of government-citizen interaction;
- increased efficiency, both of single purpose infrastructure systems and of integrated ones; and
- replacement of some portion of the transportation system by less expensive communication systems.

New communication technologies, together with robotics, could improve the inspection, maintenance, and repair of infrastructure systems.

The conference report noted that new communication technologies, together with robotics, could form the basis for research and development projects designed to improve the inspection, maintenance, and repair of infrastructure systems.[5]

For example, some benefits of information systems will be tested in California's proposed telecommuting demonstration project. The project is designed to allow 200 state employees to work most of the time at home or in inexpensive office locations in their own neighborhoods, linked to their regular offices by computer.[6] If successful, the project would help reduce commuter congestion and avoid the expansion of costly central office space.

As cost considerations shift the emphasis in infrastructure from new construction toward better maintenance of existing facilities, engineers, planners, managers, public finance officers, and accounting professionals are recognizing the need for improved data about the condition of public works. Such data often are inadequate or nonexistent now, but new technologies recently have become available that cannot only gather condition assessment data but also store, analyze, and communicate this information much more effectively to key decision-makers and the public.

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[3] John P. Eberhard and Abram B. Bernstein, editors, *Technological Alternatives for Urban Infrastructure* (Washington, DC: National Research Council, December 1985), p. 49-50.

[4] *Ibid.*, pp. 52-55.

[5] *Ibid.*

[6] Deborah Kasouf, "California Studies Telework Pilot Project," *Public Administration Times*, Vol. 9, No. 15, August 1, 1986, p. 3.

Among the techniques for gathering these data are ground penetrating radar, laser devices for measuring roadway deflection, acoustical resonating devices for detecting underground leakages, and infrared photography for determining voids and separations between layers of construction materials.

Small computers could be used to communicate widely the detailed data generated by these techniques, allowing elected officials, top management, and the public at large to learn the status of public works more precisely and on a more timely basis. Computers already are indispensable to virtually every phase of public works activity, from the most technical research projects to planning and decision-making, accounting and finance, and maintenance scheduling. The recent development of such low-cost micro-computer capability offers the potential to put significant new techniques at the command of even the smaller public works offices.

Low-cost micro-computer capability offers new techniques for use in public works management.

During the past several years, engineering firms, public works departments, industry associations, research institutions, and software development firms have created extensive software for use in public works management.[7] Much of this software now is available to micro'' and mini-computer users. However, the capability, sophistication, and versatility of these software packages vary greatly, as do the quality and availability of documentation and user support.

Three different kinds of software have the potential to improve public works management. First, a number of better managed public works organizations have implemented inventory, scheduling, budgeting, work order, performance measurement, and other systems.

Second, substantial advances have been made in automated mapping and facilities management systems that portray infrastructure systems graphically. These systems link data on public facilities (street width, lane miles, condition, and traffic volume) to specific coordinates or nodes on a map so that related facilities and conditions can be analyzed together and communicated effectively to the managers, citizens, and policy-makers who must decide on needed improvements.

Third, decision-support and modeling programs are being developed for repair versus replacement analysis. Such systems are generalized analytical tools for evaluating current maintenance costs, future expected maintenance costs with and without repairs, replacement costs, and existing and revised expected asset life. These systems are being improved gradually, and are coming into more general use.

Such new management tools require continued evaluation and refinement. More widespread use of modestly priced software systems has been restricted by the general lack of awareness of their capabilities and availability, the lack of personnel trained in their use, and their start-up costs. Except for larger cities and counties and some states, the ability to implement these systems is limited. Nevertheless, their costs and technical user requirements have declined, and it now is feasible to gather and evaluate comparative information regarding system costs, capabilities, performance, and use, and to make such data available to a wider universe of potential purchasers. Numerous publications and short courses are available on the subject now; a number of information system consultants are marketing their products actively through free seminars and other means; and many professional organizations are providing assistance to their members to help them keep up with new developments in this rapidly expanding field.

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[7] The following information about software development is drawn from Deloitte, Haskins and Sells in association with CH_2M Hill and Berkeley Planning Associates, "A Review of Current Capital Budgeting and Public Works Management Practices," report to the National Council on Public Works Improvement, July 1, 1986, pp 28-29.

Technological Advances for Specific Types of Infrastructure

Opportunities also exist for technological advances that could benefit each type of infrastructure system. The potential for such advances has been studied most thoroughly in the highway field[8], and is being examined now for transit by the Transportation Research Board (TRB).

The Strategic Highway Research Program ... promises to pay off handsomely, as has past highway research.

The TRB highway study resulted in a Strategic Highway Research Program to (1) improve the performance and durability of asphalt and Portland cement pavements; (2) establish new performance and cost data on various types of highway construction and maintenance practices under diverse conditions; (3) find new ways to prolong the life of concrete bridge components and structures; (4) find less damaging means of melting snow on highways than the current use of salt; and (5) improve maintenance practices. These are all relatively near-term projects. They promise to pay off handsomely, as has past highway research. For example, previous research efforts have:

- developed techniques that have reduced dead weight in bridge designs; such techniques include high-strength steel reinforcing bars (saving $30 million per year), prestressed concrete, box girders, cable-stayed spans, and additives that make concrete stronger, easier to handle, and quicker to set;
- increased the safety of highways with breakaway poles, impact attenuation devices, guardrails that redirect vehicles, headlight screens, more legible lane markings and signs, better skid resistance from improved pavement surfaces, and the virtual elimination of tire hydroplaning on urban freeways by using grooved pavements (originally developed by NASA to reduce hydroplaning of aircraft tires on runways); and
- improved the economics of construction materials by finding new ways to stabilize soils, providing more precise means of evaluating the usefulness of mineral aggregates, enhancing the natural strength and durability of some mineral aggregates, and manufacturing aggregates where they are not conveniently available in natural deposits.[9]

Nevertheless, the present Strategic Highway Research Program, being pursued cooperatively by the National Academy of Sciences, the Federal Highway Administration, and the American Association of State Highway and Transportation Officials, does not include longer term, potentially higher payoff, but more speculative research designed to find wholly new materials and techniques.[10] A segmented research agenda incorporating both long-term and short-term objectives would address this concern.

Technological innovations hold promise for meeting infrastructure needs in many areas other than transportation. For example, in solid waste disposal, potential exists for (1) finding better techniques for recovering usable resources and energy from wastes, (2) using waste products as a component of construction materials, and (3) modifying packaging materials (which comprise much of the volume of wastes) to make them more usable as fuels or more biodegradable. In fact, such benefits already are being realized in a number of instances where energy produced from wastes is being used in district heating systems (often on college campuses), and where old asphalt pavements are being recycled into new highway surfaces.

Water supply systems may benefit from technological advances that reduce water losses.

Water supply systems may benefit from technological advances that reduce water losses from evaporation and leaks (especially in agricultural irrigation), conserve water in facilities such as showers and toilets, recycle used water, and improve desalinization. Technologies already are available for these purposes, and are applied to a limited extent where economic and other conditions are favorable. Water pipe rehabilitation, rather than more costly replacement, is becoming increasingly practical.

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[8] Transportation Research Board, *America's Highways: Accelerating the Search for Innovation* (Washington, DC: National Research Council, 1984).
[9] These examples are drawn from *Ibid.*, pp. 13-26.
[10] [illegible], *op. cit.*

Sewage disposal might benefit from improved technologies for pipe rehabilitation . . .

Sewage disposal might benefit from improved technologies for pipe rehabilitation, flow monitoring and control, detection of hazardous materials, water conservation, and sludge management. Already, video systems have added enormously to the ability to inspect sewer pipes, and inexpensive pipe linings are being installed to rehabilitate old pipes instead of digging them up and replacing them.

The most significant new storm drainage and flood control technologies, however, may include such future possibilities as new ground covers that absorb water and release it slowly. More immediate incremental improvements might be expected in the construction and maintenance of flood control structures and improved flood warning systems. One example is the set of four systems of tunnels and underground reservoirs being developed by the Metropolitan Sanitary District of Greater Chicago to control overflows from combined storm and sanitary sewers and to reduce flooding.[11] Using the most up-to-date tunneling equipment, over 37 miles of the system have been put into operation and another 3.5 miles were under construction as of the beginning of 1986. When completed, Phase I of the project will capture 85 percent of the combined sewer overflows in the Chicago area, and Phase II will add substantial flood control benefits. This $3.8 billion project, which is incorporating many equipment and operating innovations, is running under budget and ahead of schedule. It received the 1986 Outstanding Civil Engineering Achievement Award from the American Society of Civil Engineers.

Technology's Potential to Help Manage Demand for Public Works Services

Technological advances may affect individual lifestyles, and thereby change the demand for various public and private components of infrastructure. For example, local building codes could be used to encourage developers to provide water saving and energy conservation devices, or other means of reducing demands for public infrastructure, when designing and constructing private buildings.

. . . new telecommunications infrastructure [are] necessary to growth

In addition, telecommunications systems are changing the way the nation carries on its business, including land development patterns. These changes depend upon new telecommunications infrastructure, in much the same way that railroads and highways were necessary to the growth of heavy industry and manufacturing.[12]

Cities may take the initiative in designing, planning for, and providing a greater portion of these networks. For example, a recent study by the Port Authority of New York and New Jersey found that "frequency congestion, along with the high cost of locating critical data-processing centers in older Manhattan buildings, has driven several businesses out of the area."[13] The study went on to observe that unless the problem was addressed, the region would experience a continuing erosion of jobs and business activity in the very sector in which it has maintained international dominance.[14] In response to this concern, the Port Authority, in cooperation with the city and the private sector, is planning a teleport that will be a satellite communications center and office park. The 350-acre site will be equipped with 17 "earth stations" that will transmit and receive voice, data, video, and facsimile transmissions to and from domestic and Intelsat communication satellites linking the United States and Europe.

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[11] Rita Robinson, "The Tunnel that Cleaned Up Chicago," *Civil Engineering*, Vol. 56, No. 7, July 1986, pp. 34-37.

[12] Frank S. So and Judith Getzels, "The Planning Profession and Public Works", paper prepared for the National Council on Public Works Improvement by the American Planning Association, July 1, 1986; and William Blazar, "Special Report: Telecommunications, A Means to Sharpen Tools," *Nation's Cities Weekly* (Washington, D.C.: April 14, 1986), pp. 5-7.

[13] "The Teleport—A Satellite Communication Center/Office Park," (The Port Authority of New York and New Jersey, 1982), p. 1, cited in Bamberger, Blazar and Peterson, *Infrastructure Support for Economic Development* (Chicago: American Planning Association, 1985), p. 24.

[14] *Ibid.*

Another example of innovative use of telecommunications in local development can be found in Portland, Oregon. Since 1982, the city has worked with a local cable television franchise to develop a business information network. The two-way coaxial cable network provides opportunities for data transmission (point-to-point, multipoint, and packet switching), access to worldwide data bases (such as Reuters), and video conferencing. Similar systems are being developed in Lowell, Massachusetts, and New York City.[15]

Progress in this area has been slow, however, because of regulatory uncertainty,[16] difficulties in linking businesses in adjoining jurisdictions, and lack of public appreciation and understanding of the potential benefits of such arrangements.[17] The eventual success of these efforts will require not only new knowledge and skills from planners and public works officials, but also the installation of these new systems by both the private and public sectors.

Accelerating Technological Advances

Some technological advances will come faster than others.

Obviously, some technological advances will come faster than others in the public works field. Many advances in process technology require more development, testing, and refinement to produce systems capable of highly reliable performance. Most leading engineers believe that progress in these fields will be evolutionary, not revolutionary.[18] One major issue posed by these technological possibilities is whether, and to what extent, governments should try to accelerate them.

Strong national commitments to advanced research can produce dramatic results.

Many advocates in the scientific and engineering communities claim that new technologies and materials are available and can be borrowed from space and military research programs.[19] In fact, weapons development and space exploration programs—where strong national commitments have supported advanced research—demonstrate that science can produce dramatic results. Public works is a field where such a commitment could result in important technological advances. It seems likely that a focused, vigorous research effort, conducted with clear priorities and on a joint partnership basis between the private and public sectors, could offer the spark and buffer the risks necessary to entice new business investment in infrastructure-related industry.

The previously cited research agenda prepared by the Transportation Research Board (TRB) for near-term highway technology advances is one example of such an effort. Another is the current TRB project to prepare a similar agenda for mass transit. On an even broader scale, the American Society of Civil Engineers has developed a preliminary list of research topics that could be accelerated to meet both near- and longer-term needs in the fields of (1) transportation, (2) highways, streets, and bridges, and (3) water supply and wastewater.[20] In addition, the National Science Foundation recently elevated its support for infrastructure research by establishing a new Infrastructure Research Program.

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[15] Blazar, *op. cit.*, p. 6.

[16] Cablesystems of Portland is involved in a law suit with Pacific Northwest Bell over this common carrier issue. Pacific Northwest Bell argues that its franchise grants exclusive rights to provide personal or business communications and Cablevision's business information network violates that franchise.

[17] Bamberger, Blazar and Peterson, *op. cit.*

[18] American Academy of Environmental Engineers, *America's Environmental Public Works Realities: The Next 30 Years*, prepared for the National Council on Public Works Improvement, August 1986.

[19] For example, see American Society of Civil Engineers, *Research Needs Related to the Nation's Infrastructure* (New York, 1984).

New materials and products must be tested and evaluated.

New materials and products must be tested and evaluated to determine their effectiveness and appropriateness in satisfying various public works needs. Means to perform testing and evaluation, and to make the results available to the public works community, should be investigated and implemented. One possibility is to establish a private organization (along the lines of Underwriters Laboratories, Consumers Union, or a university-based engineering research center) to take on such tasks.

Safety concerns are a major impediment to the introduction of new technologies because of the potential risk of failure and the ensuing liability. Some means may need to be found to compensate risk-takers for new technologies that fail. The lack of such testing and initiative presents a potential barrier to widespread use of new products and methods, despite the great need for them.[21]

The local reluctance to risk new technology [may be] institutional, rather than technical.

The local reluctance to "risk" new technology was illustrated recently in the busy Port of San Francisco by a decision to remove an automated sensing system designed to measure tides and winds and to report sophisticated information about harbor conditions to boat pilots.[22] This system made it possible to increase traffic and avert costly delays in the port. The system was removed in part because of concerns about litigation if a defective sensing device was implicated in an accident. In addition, the port experienced difficulty in arranging continuing financial support from the local shipping industry, and pilots and operators disagreed on the value of the system when it was in operation. The chairman of the national committee studying the potential of such sensors for improving the operations of ports and saving money for shippers declared that: "The obstacles to installing sensing equipment are institutional, rather than technical."[23]

Much of the perceived stagnation in public works technology in the past has been ascribed to:

The Council intends to work cooperatively with numerous organizations and institutions to stimulate technological innovations.

- the absence of consistent and direct investment in applied research for public works;
- the lack of effective means to transfer information, train personnel, and hire adequate staff to support innovations already well developed and tested;
- threats of legal exposure and financial risk for the firms and communities attempting to test and implement new materials, equipment, or procedures;
- the reluctance of established public works personnel, suppliers, and contractors to alter current materials and practices; and
- Federal, state, and local regulatory requirements that impede innovation.

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[20] *Ibid.*

[21] The U.S. Army Corps of Engineers recently has initiated a Facilities Technology Application Test Program (FTAT) to help mitigate this obstacle. The first reports from this program are due to be published soon and a community information sharing program is being planned—using papers, video tapes, and seminars.

[22] Marine Board, Commission on Engineering and Technical Systems, *Advances in Environmental Data Services to Ports: [illegible] Application and Technology* (Washington, DC: National Research Council, 1986).

[23] [illegible] Ward, "[illegible]," *News Report* (Washington, DC: National Research Council, May 1986), p. 38.

In view of the foregoing discussion, the Council intends to work cooperatively with numerous organizations and institutions to stimulate approaches that would (1) effectively set priorities and promote public works research and technological innovations, (2) identify institutional impediments at all levels of government to the transfer of existing technologies to larger numbers of public works organizations, and (3) disseminate information widely about effective new public works technologies.

Chapter V Economic and Finance Issues

This chapter examines (1) the importance of public works to the nation's economy, (2) recent trends in spending for public works, (3) how those expenditures have been financed, and (4) emerging financing tools that might be used to meet future expenditure needs.

The Importance of Infrastructure to the Economy

Public works are not ends in themselves. Rather, their importance to the economy and society derives from the flow of services they provide. For example, public works facilities aid:

- daily movement of people to and from work, school, and shopping;
- distribution of raw materials and intermediate and finished goods throughout the nation's economy;
- access to recreational activities; and
- improvements in the quality of life and a cleaner and safer environment.

The importance of infrastructure to the economy is generally acknowledged, but its precise impact is difficult to quantify. For example, what would society be like if no canals, railroads, or urban water and interstate highway systems had been built?

The health of the nation's economy and the stability of society are dependent on the existence of a well maintained infrastructure.

The health of the nation's economy and the stability of society are dependent on the existence of a well maintained infrastructure. Furthermore, it is clear that public and private components of infrastructure systems form a seamless web of activities that permeate the economy. While the line between public and private is difficult to define, this general relationship is illustrated by Table V-1.

Total spending—capital plus operating and maintenance—for public works (as defined by the Council)[1] was $97.3 billion in 1984. This amounted to about 2.7 percent of the nation's gross national product (GNP). While substantial, this figure underestimates significantly the full impact of infrastructure on the economy; it does not include:

- the indirect effect of spending for infrastructure as it ripples through the rest of the economy;
- the safety benefits provided by the infrastructure system or the economic drain from lack of safety;
- private entities that provide public services and industries—such as trucking and autos—that rely heavily on infrastructure for their livelihood; and
- broader definitions of infrastructure that might include, for example, privately owned railroads and pipelines.

The link between capital planning and economic development planning needs to be strengthened.

Given the importance of public works to the economy and the increased attention that state and local governments are paying to economic development concerns, decision makers at all levels have considerable incentive to explore the impact of alternative infrastructure expenditures on productivity, jobs, and the incomes of families, firms, and governments themselves. For this reason, it has been argued that the link between capital planning and economic development planning needs to be strengthened.[2]

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[1] Included under this definition are the following facilities: highways, roads, bridges, mass transit systems, water resources structures (dams, waterways, ports, and harbors), wastewater treatment plants, drinking water facilities, municipal solid waste facilities, and airports and airways.

[2] Rita Bamberger, William Blazar, and George Peterson, *Infrastructure Support for Economic Development* (Chicago: American Planning Association, 1985).

TABLE V-1
EXAMPLES OF PUBLIC AND PRIVATE COMPONENTS OF INFRASTRUCTURE SYSTEMS

Infrastructure System	Public Components	Private Components
Water	Dams, reservoirs, pipelines, purification stations	Sinks, showers, water fountains, sprinklers, washing machines
Energy	Oil and gas wells, pipelines, electric power generating stations, transmission lines, transformers	Furnaces, heaters, air conditioners, fans
Waste Disposal	Sewers, sewage treatment plants, garbage trucks, dumps, landfills, incinerators	Toilets, garbage disposals, trash compactors, trash cans
Communication	Post offices, mail trucks, telephone lines and cables, broadcasting stations and transmitters, satellites	Mailboxes, telephones, radios, television sets
Transportation	Highways, bridges, tunnels, railroad tracks, airports, seaports	Automobiles, buses, trucks, railroad tracks, trains, airplanes, boats

[illegible] (Washington, DC: [illegible]

To improve the allocation of infrastructure expenditures among competing projects (and to justify additional resources), the contribution of public works spending to economic development should be better documented.[2] The extent of such benefits depends on the degree to which businesses (or individuals) rely on the public infrastructure, and on how the cost of construction and maintenance is allocated between residents and non-residents, and between firms and individuals.

. . . the contribution of public works spending to economic development should be better documented.

Public infrastructure expenditures affect not only local users, but also the overall level of economic activity in a region or the nation.[3] Examples include the impact of the Federal highway program on suburbanization and mobility generally, and the impact of the railroads on the development of the West. These infrastructure investments produced significant national benefits, though their local and regional benefits were mixed.

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[2] A review of the infrastructure and economic development linkage is provided by Randall W. Eberts, "An Assessment of the Linkage Between Public Infrastructure and Economic Development," prepared for the National Council on Public Works Improvement, July 1986, and Therese J. McGuire, "On the Relationship Between Infrastructure Investment and Economic Development," prepared for the National Council on Public Works Improvement, July 1986.

[3] Eberts, op. cit., pp. 13-21.

As a targeted development tool, however, public works investment has been less successful, in part because such investments tend to move economic activity around rather than stimulate new productive capacity, and because they cannot compensate for other economic limitations. In fact, it is difficult to make major changes in economic development patterns simply by building infrastructure systems. Often they remain unused or underutilized, which indicates an inefficient allocation of investment resources.

Infrastructure expenditures are necessary, but not sufficient, for economic development.

This scenario suggests that infrastructure expenditures are necessary, but not sufficient, for economic development. To get maximum benefit from such expenditures, one must know how the investment or lack of investment affects firms and individuals, and how costs are allocated among potential beneficiaries. The research needed to put these pieces of the puzzle together is substantial, but it may be critically important for setting infrastructure expenditure priorities.

The few empirical economic studies that address these topics show first, that local public investments and private capital spending are complements, implying that a specific level of infrastructure is necessary to support a given level of private investment,[5] and second, that benefits to national, regional, and local economies (and tax bases) from public infrastructure investments generally are similar to those of private capital investments if the two are synchronized.[6]

It is essential to the nation's economic health and international competitive position, and for continued improvement in the quality of life, that consideration of the relationship of public works expenditures to the benefits that reasonably can be expected to follow be based on sound economic analysis. However, economists have yet to measure precisely the economic stimulus provided by each type of infrastructure system, and how that stimulus is transmitted to firms and individuals. To address that task, several issues must be explored, including: (1) the interrelationship of public infrastructure with private production and consumption processes; (2) the effect of the changing nature of the economy on the demand for public infrastructure; (3) the influence of public infrastructure on decisions to open new businesses, or to expand, contract or close existing businesses; and (4) the variation in net benefits for firms and individuals, and alternative financing methods that might achieve a better balance between costs and benefits.

Public Works Expenditure Trends

The growth rate of public works investment has slowed.

The growth rate of public works investment has slowed significantly over the past three decades compared with the growth rate of net private capital formation. This trend has been associated in some studies with deterioration in the nation's infrastructure, and it raises the question of whether future expansion of the economy can be sustained by present rates of public works investment.[8] This issue is of importance not only to the nation as a whole, but also to state and local governments as they compete more aggressively for new businesses and growth.

Trends in public works expenditures provide some insight into the adequacy of the nation's infrastructure. For example, both Federal and non-Federal capital outlays increased substantially in current dollars between 1960 and 1969 (a period marked by heightened construction of the Interstate Highway System). However, aggregate construction outlays by all levels of government declined after 1972, with only a short period of increase in 1979 and 1980. Generally, this trend is explained by reductions in state and local capital spending since 1972, which more than offset modest increases in Federal capital outlays throughout the 1970s (largely resulting from increased Federal capital grants for wastewater treatment). Total spending for public works (construction plus operation and maintenance) has fallen from about 13.5 percent of all government spending in the early-to-mid-1960s to 6.6 percent in 1984 (see Figure V-1).

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[5] Kevin Deno, *The Short-Run Relationship Between Investment in Public Infrastructure and the Formulation of Private Capital*, Ph.D. Dissertation, University of Oregon, Eugene, OR (1986).

[6] Koichi Mera, "Regional Production Functions and Social Overhead Capital: An Analysis of the Japanese Case," *Regional and Urban Economics*, 3(2), 1973, pp. 157-86.

[7] This section relies heavily on two reports prepared for the National Council on Public Works Improvement: Apogee Research, Inc., "Trends in Public Works Expenditures, 1960-84," July 1986, and William F. Fox, "Expenditures for Public Works Infrastructure," July 1986.

[8] Eberts, op. cit.

. . . government spending devoted to operating and maintaining existing public works more than doubled . . . from 1960 to . . . 1984.

Over the same period, government spending devoted to operating and maintaining existing public works more than doubled in real terms (constant 1984 dollars) from $21.6 billon in 1960 to $56.5 billion in 1984 (see Figure V-2); more is being spent now to keep existing facilities performing than to create new ones. During this period (1) one of the nation's largest public works construction projects—the Interstate Highway System—was nearly completed; (2) the low matching requirements of Federal highway grants of the 1960s to early 1970s and then of Federal grants for wastewater treatment facilities allowed states and localities the flexibility to spend more on the maintenance and operation of their existing stock; and (3) the rapid rise in real interest rates in the 1970s discouraged all new construction, public as well as private.[9]

These spending trends reflect political and social judgments. As such judgments shift over time, so do budget numbers. This is true historically as well as currently. For example, analyzing expenditures on transportation facilities in the 19th century—canals, turnpikes, and railroads—not only indicates how the nation grew, but also provides a basis for understanding the economic development process and the tradeoffs society made in pursuit of its economic goals. Similarly, in the period following World War II, the impact of the "baby boom" can be observed in school construction expenditures, and rapid suburbanization can be traced through spending for interstate highways and wastewater treatment facilities.

An examination of recent expenditure trends illustrates current public works investment issues. To highlight different aspects of these trends over the 1960-1984 period, they are explored further here, first in the aggregate[10] and then by the different levels of government and for separate types of facilities.

Aggregate Spending

Total real spending for public works increased from about $60 billion in 1960 to about $97 billon in 1984. Much of this increase occurred between 1960 and 1972, with real spending growing at an average rate of 3.4 percent per year. After 1972, however, increases slowed considerably, resulting in a 1972-1984 growth rate of only 0.6 percent per year.

Aggregate Spending as a Percent of GNP. Expressing public works expenditures as a percent of the country's Gross National Product (GNP) gives a general idea of

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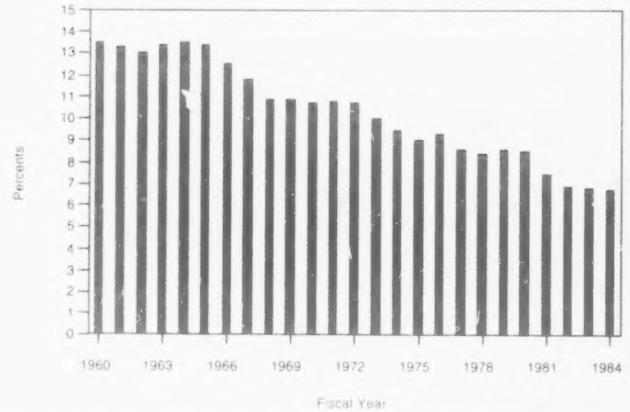
[9] While these trends may have contributed to the increasing relative importance of operating and maintenance expenditures, it is difficult to explain definitively this increasing importance because the data cannot be disaggregated into their component parts. Further information on the extent of maintenance expenditures versus operating expenses is needed.

[10] Throughout this section, the term "public works" refers to a definition that includes the following facilities: highways, roads, bridges, mass transit systems, water resources structures (dams, waterways, ports, and harbors), wastewater treatment plants, drinking water facilities, municipal solid waste facilities, and airports and airways.

FIGURE V-1
TOTAL PUBLIC WORKS SPENDING AS A PERCENT OF TOTAL PUBLIC EXPENDITURES



Source: *Trends in Public Works Expenditures, 1960–1984.* A report prepared for the Council by Apogee Research, June 1, 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987,* Office of Management and Budget (Washington, DC: Government Printing Office, 1986); *Governmental Finances* (annual issues), Bureau of the Census, United States Department of Commerce (Washington, DC: Government Printing Office, selected years); and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, United States Department of Housing and Urban Development, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

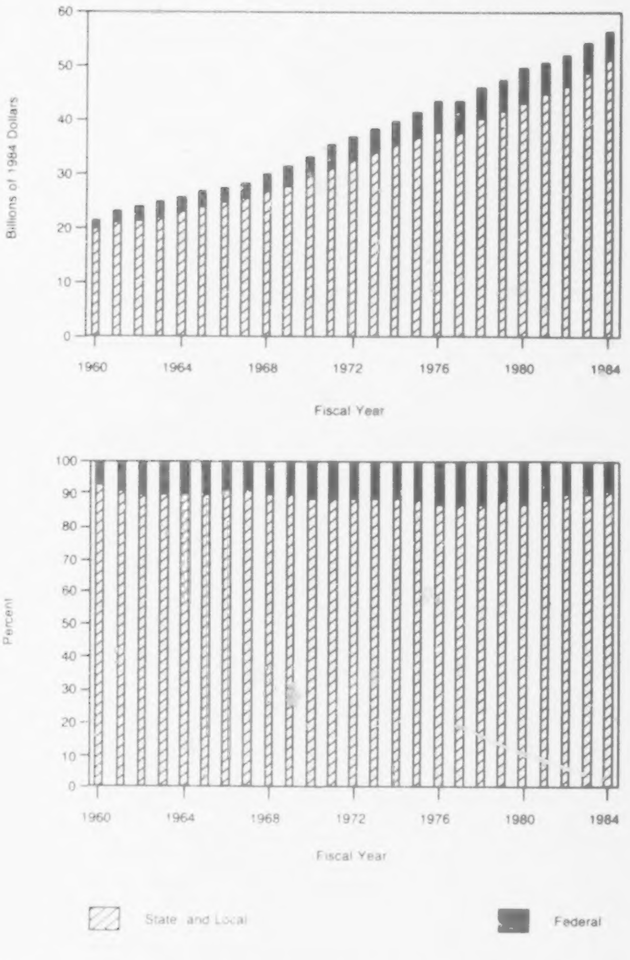
the growth in building, operating, and maintaining public works structures relative to growth in the overall economy. However, because this ratio does not measure level of service or the efficiency of public works operations, it cannot support a conclusion that falling ratios over time indicate underinvestment in physical infrastructure, or vice-versa.

This relationship from 1960 to 1984 is presented in Figure V-3. The data for all governments are divided into maintenance and operating versus capital components. Total annual spending for public works by all levels of government as a portion of GNP has fallen from about 3.7 percent in 1961 to 2.7 percent in 1984. This decline is due largely to a marked drop-off in capital expenditures (the 1984 ratio is half the peak reached in 1963) and an increase—but not an offsetting increase—in operation and maintenance outlays. These data are consistent with the hypothesis that the public sector indeed has shifted its primary focus from building new stock to maintaining its existing capital base. Whether this shift is desirable and/or the resources available for maintenance and operation are sufficient to meet present needs or future service demands remains an issue to be explored in future Council reports.

Total annual spending for public works by all levels of government as a portion of GNP has fallen from about 3.7 percent in 1961 to 2.7 percent in 1984.

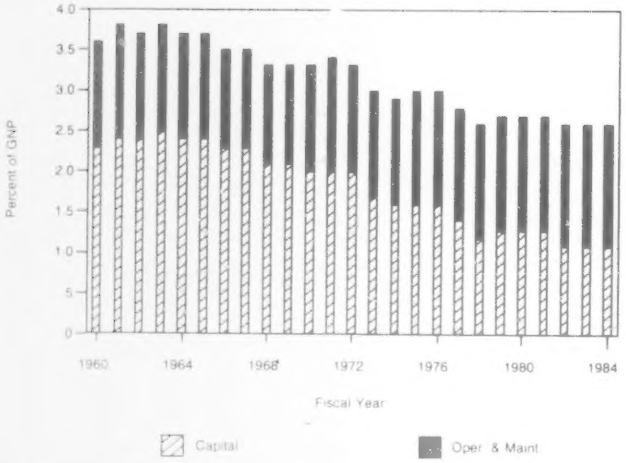
Aggregate Spending Per Capita. The average benefits of public works also can be measured by tracking infrastructure spending on a per capita basis. Rising per capita spending generally is taken to mean that the population is receiving an increased flow of public works services over time. Again, however, the conclusion suggests only the general direction of change. Using these data alone, it cannot be determined whether these services are adequate, or whether the cost of sacrificed alternatives is less (or greater) than the benefits. In addition, these per capita figures are national averages, and do not reflect significant regional and sub-regional variations in the trends.

FIGURE V-2
TOTAL PUBLIC WORKS SPENDING FOR OPERATIONS AND MAINTENANCE BY LEVEL OF GOVERNMENT



Source: *Trends in Public Works Expenditures, 1960-1984.* A report prepared for the Council by Apogee Research, June 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987* (Office of Management and Budget) (Washington, DC: Government Printing Office, 1986); *Governmental Finances* (various years), Bureau of the Census, United States Department of Commerce (Washington, DC: Government Printing Office); selected states; and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, United States Department of Housing and Urban Development, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

FIGURE V-3
TOTAL PUBLIC OUTLAYS
(CAPITAL AND OPERATIONS & MAINTENANCE)
AS A PERCENT OF GNP



Source: *Trends in Public Works Expenditures, 1960-1984.* A report prepared for the Council by Apogee Research, July 1, 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987* Office of Management and Budget. (Washington, DC: Government Printing Office, 1986) *Governmental Finances* (various years). Bureau of the Census, United States Department of Commerce. (Washington, DC: Government Printing Office, selected years) and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, United States Department of Housing and Urban Development, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

Public works spending in constant dollars increased from $330 per person in 1960 to $411 in 1984.

What emerges from an examination of per capita ratios in conjunction with other indices and trends is uncertainty about the widely publicized notion that the nation has ignored its infrastructure needs in recent years. The most recent data show that public works spending in constant dollars increased from $330 per person in 1960 to $411 in 1984. If this ratio is separated into capital versus operation and maintenance components, per capita outlays for capital have declined over the period—from a peak of $266 in 1967 to $170 in 1984—whereas operating and maintenance expenditures have doubled—from $120 per capita in 1960 to $240 in 1984. These data need to be examined in greater detail to determine what they actually imply about the levels of service provided by public works facilities.

Types of Facilities Funded

. . . major shifts [in the composition of public works investment] occurred between 1960 and 1980.

Another important change in the composition of public works investment is revealed by examining the purposes of infrastructure spending. As shown in Table V-2, major shifts occurred between 1960 and 1980. The 1960s were dominated by highway projects (60 percent of total public works investment in 1960), with spending on water resources and water supply a distant second. After 1970, however, the relative importance of highway spending began to decline as spending for other facilities—particularly wastewater and mass transit—grew. In the 1980s, highway spending has continued its relative decline, while mass transit, including operating subsidies, continues to account for an increasing share. The relative importance of expenditures for wastewater, water supply, and solid waste have remained comparatively stable since 1980.

TABLE V-2

COMPOSITION OF PUBLIC WORKS SPENDING BY MODE, SELECTED YEARS
(In Millions of 1984 Dollars and Percents)

System Mode	1960		1970		1980		1984	
Highways								
Federal	$12,193		$13,952		$11,395		$10,981	
State	15,498		22,962		18,745		17,147	
Local	8,574		11,192		11,477		11,997	
Total	36,265	60%	48,106	57%	41,617	43%	40,125	41%
Airports								
Federal	1,649		2,789		3,925		3,800	
State	83		475		341		311	
Local	1,002		2,142		1,913		2,506	
Total	2,734	5%	5,406	6%	6,179	6%	6,617	7%
Mass Transit								
Federal	0		104		4,224		3,828	
State	579		990		1,475		2,109	
Local	1,856		2,060		4,927		7,333	
Total	2,435	4%	3,154	5%	10,626	11%	13,270	14%
Water Resources								
Federal	4,455		4,598		4,576		3,786	
State	1,045		2,056		1,704		1,816	
Local	840		1,029		1,467		1,368	
Total	6,340	10%	7,683	9%	7,747	8%	6,970	7%
Wastewater								
Federal	165		808		5,659		2,969	
State	123		172		234		190	
Local	3,959		5,334		6,694		8,707	
Total	4,247	7%	6,314	8%	12,587	13%	11,866	12%
Water Supply								
Federal	365		570		1,880		580	
State	0		122		400		946	
Local	6,170		7,968		11,610		12,514	
Total	6,472	11%	8,660	10%	13,890	14%	14,040	14%
Solid Waste								
Federal	0		0		0		0	
State	0		0		0		0	
Local	2,356		3,127		4,221		4,710	
Total	2,356	4%	3,127	4%	4,221	4%	4,710	5%
TOTAL	$60,449		$83,845		$96,367		$97,598	
Federal	18,627	31%	23,021	27%	31,159	32%	25,944	27%
State	17,328	29%	26,777	32%	22,899	24%	22,519	23%
Local	24,494	40%	34,047	41%	42,309	44%	49,135	50%

Source: *Trends in Public Works Expenditures, 1960-1984*, a report prepared for the Council by Apogee Research, July 1, 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987*, Office of Management and Budget (Washington, DC: Government Printing Office, 1986); *Governmental Finances* (various years), Bureau of the Census, United States Department of Commerce (Washington, DC: Government Printing Office, selected years) and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, United States Department of Housing and Urban Development, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

Level of Government

. . . local governments have taken on more of the responsibility for building . . . operating and maintaining . . . public works.

Relative public works spending by level of government has changed also. Figure V-4 reveals an increase in the local share of infrastructure spending from 1960 to 1984. This shift has been most rapid since 1980, as local governments have taken on more of the responsibility for building local water supply, wastewater treatment, solid waste, and transit facilities, and have faced increasing costs for operating and maintaining all forms of public works. In contrast, the relative role of the states has declined, while the Federal role has been characterized by temporary bursts of spending due largely to capital outlays for highways (1960s), wastewater grants (1970s), and mass transit (early 1980s).

Expenditure Data Limitations

As significant as these expenditure data are, they have only limited usefulness in explaining trends.[11] Within this context the following caveats are particularly important.

Expenditure data have . . . limited usefulness in explaining trends.

- First, the capital component of public works expenditures often is only an input in the production of public services, while it is the output that ultimately is of policy concern. For example, consumers demand a certain quality of water. Thus, the need for a treatment and distribution system must be viewed in the context of how such a system affects services provided.
- Second, expenditure data are not meaningful unless the user understands that these funds could be spent on other public or private goods. If each extra dollar spent on public works investments were free to society, in terms of not having to sacrifice resources for other uses, more infrastructure expenditures always would be preferred to less. However, such zero cost conditions do not exist.
- Third, national estimates of public works expenditures made by Federal agencies are based on standardized definitions and measurement techniques. This standardization is crucial if the numbers are to be used for any consistent discussion of nationwide issues. However, national trends that are identified in this way may not necessarily hold for any given state or locality. Moreover, because states do not apply uniform standards in measuring spending (including the definition of capital versus operating expenditures), their annual reports fail to provide reliable data for comparing infrastructure conditions nationally.
- Fourth, because the data collected are aggregated, it is not clear what is included in public works improvement "outlays." For example, operating and maintenance figures are not separated. Indeed, these expenses may include items not necessarily related to infrastructure, such as equipment (*e.g.*, a fleet of trucks) or building improvements (e.g., new workshops for repair or maintenance).
- Finally, public works expenditure data do not provide information on whether the services provided by the nation's infrastructure have declined. Yet, such information is of central concern in decisions to allocate scarce public works dollars.

In addressing these concerns, it must be recognized that data needs may vary among levels of government, in accordance with shifting responsibilities for infrastructure spending and development.

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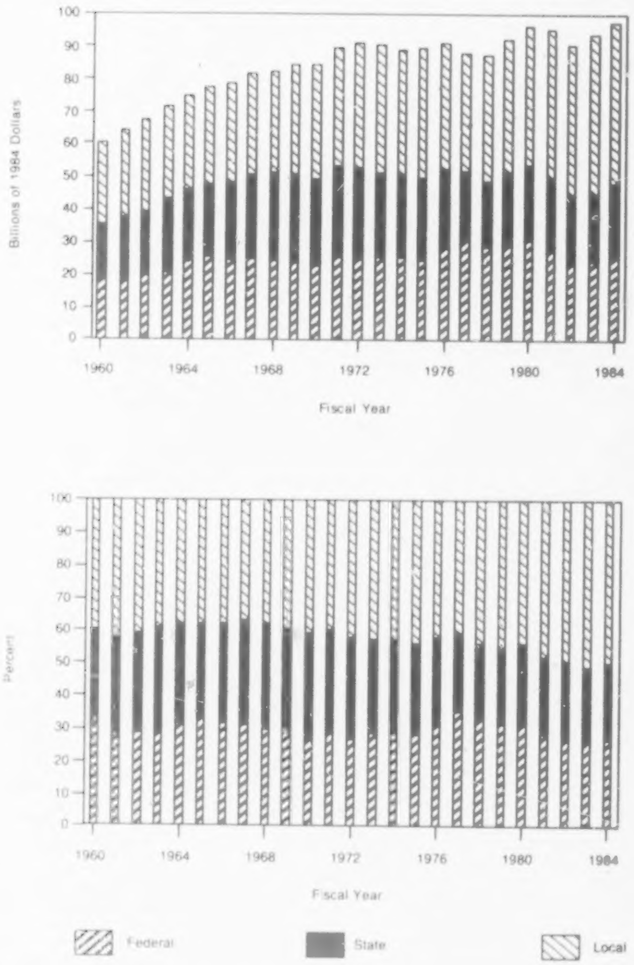
[11] A general discussion of the nature, strengths and weaknesses of expenditure and revenue data sources is provided in Appendix D.

FIGURE V-4

COMPOSITION OF TOTAL PUBLIC WORKS SPENDING BY LEVEL OF GOVERNMENT



SOURCE: *Trends in Public Works Expenditures, 1960-1984.* A report prepared for the Council by Apogee Research, July 1, 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987,* Office of Management and Budget (Washington, DC: Government Printing Office, 1986); *Governmental Finances* (various years), Bureau of the Census, United States Department of Commerce (Washington, DC: Government Printing Office, selected years) and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, United States Department of Housing and Urban Development, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

Financing Public Works[12]

During the past several years, policies for financing infrastructure have undergone marked change.

During the past several years, policies for financing infrastructure have undergone marked change. This reevaluation of how governments can and should pay for public works can be attributed to a combination of factors, including political and economic developments such as increased citizen resistance to tax increases, tax competitiveness among the states, and a reassessment of the Federal role in financing state and local spending for all purposes, including public works.

As a consequence of these developments, it will be increasingly necessary to rethink how society will pay for its future infrastructure needs—both new capital plant and maintenance of existing stock. Not only are recent political and economic trends likely to continue, but Federal tax legislation probably will change intergovernmental financing rules. Indeed, the convergence of these forces makes the question of how the nation will finance its public works in the decade ahead a major issue.

The purpose of the following discussion is to identify key trends and issues for further analysis. Accordingly, this section reviews the relationship between public works expenditure and financing data, examines the general trends in the funding of public works, and then identifies some of the emerging debt and "non-debt" tools employed in such financing.

Taxing and Spending Linkages

Infrastructure spending and revenue raising activities are linked closely—even if their decision-making processes are not coordinated. In the final analysis, expenditures must be paid for out of current revenues—taxes or fees—even if these are assessed to pay debt service. In some cases, revenue streams are earmarked for infrastructure purposes—e.g., gasoline taxes and some state lotteries. However, tracing a direct linkage between specific public works expenditures and the revenues used to finance them is an uncertain exercise at best.

Tracing a direct linkage between specific public works expenditures and revenues . . . is an uncertain exercise.

This is true for several reasons. First, available national data sources attribute expenditures to the spending jurisdiction and revenues to the unit that generates them. In these data sources, revenues generally are reported much later than when they are collected, while expenditures often are reported when the funds actually are spent, rather than when the projects they pay for are approved.

Second, revenues are "fungible"—that is, they can be shifted across categories and used for purposes other than those originally intended. For example, the Federal government may provide a grant for the same purpose for which a local government already was planning to spend its own resources. Unless the local government spends more on the service than it intended originally, it can be argued that the Federal money allows local funds to be used for other purposes.

Third, because of the pass-through nature of many Federal grants to state and local governments, aggregate expenditures may reflect double counting—that is, some spending may be counted at both the state and local levels. Thus, even over time, public works expenditures and revenues may not correlate.

Finally, it is difficult to establish a link between revenue sources and public works expenditures financed on a pay-as-you-go basis out of the general fund. Because the data aggregate general fund revenues, it is impossible to say with accuracy what percent of a new fire truck was paid for from property taxes or a local income or sales tax. To the extent that linking spending and financing decisions improves the allocation of public works expenditures, the relative merits of relying on enterprise funds and/or dedicated revenues rather than general fund revenues need to be explored.

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[12] This section draws on two reports prepared for the National Council on Public Works Improvement: Apogee Research, Inc., "Trends in Financing Public Works, 1960-84," July 1986, and William F. Fox, "Revenue Sources for Public Works Infrastructure," July 1986.

Two important tax-spending linkages can be identified . . .

Despite these caveats, two important tax-spending linkages can be identified. First, governments must levy taxes or fees to pay for public works. In this context, intergovernmental aid shifts the revenue raising responsibility from the government that spends to the unit that pays. Similarly, debt is only an interim source of funds. Here the issue is one of timing, with funds needed up front to finance investment outlays, while taxes and fees must be imposed on future users and taxpayers to repay the debt. In other words, these debt and intergovernmental sources are intermediate financing mechanisms that shift ultimate payment for capital investment to those who bear the future taxes and fees assessed to service the debt or fund the grants.

. . . first, governments must levy taxes or fees to pay for public works . . .

The second type of revenue-expenditure link stems from the earmarking or dedicating of revenues for specific public works activities. These kinds of mechanisms, which may grow in importance over the next decade as state and local governments confront increasing responsibility for financing public works, including:

- direct user fees and charges (e.g., highway tolls, water and sewage fees, transit fares);
- dedicated revenues (e.g, motor fuel taxes for roadways and in some states lottery revenues and a portion of broad-based levies such as sales taxes);
- impact and developer fees extracted from private developers as a condition for issuing building permits, occupancy certificates, and/or zoning changes; and
- tax increment financing techniques associated with the real property tax.

. . . second, governments earmark or dedicate revenues for specific public works activities.

General Trends in Financing

The remainder of this chapter reviews the major trends in financing public works, focusing on the three traditional sources of funding: intergovernmental aid, state and local debt instruments, and "own source revenues."[13] This discussion provides a backdrop for consideration of emerging alternatives to traditional financing tools.

Public works expenditures, once approved, traditionally are financed in one or more of the following ways:

- by receiving aid (direct and indirect) from another unit of government;
- by issuing tax-exempt debt where the principal raised is repaid over time, with interest, from future tax and fee revenues; or
- through current taxes and/or fees.

These three alternatives are discussed briefly below.

Intergovernmental Aid. Five types of intergovernmental aid for infrastructure finance are outlined below. The first four are Federal-to-state and/or local—namely, direct Federal grants, cooperative agreements, loans and loan guarantees, and tax expenditures. The fifth is state assistance to local governments.

a. *Federal Grants.* The sources of funds used to finance state and local public works changed significantly between 1960 and 1984. As shown in Figure V-5, direct Federal grants financed about one-third of state and local public works outlays between 1960 and 1975.

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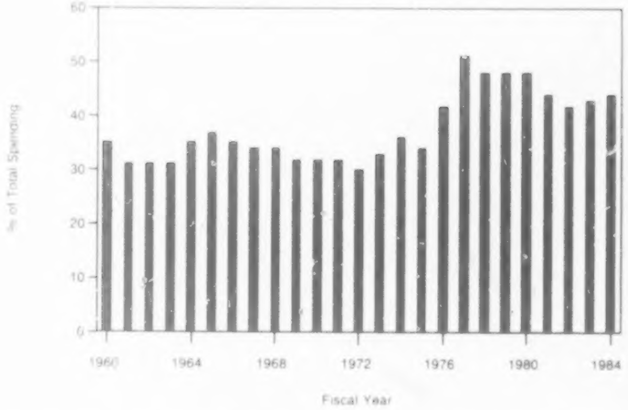
[13] These revenues are levied and collected by the same political jurisdiction that spends them.

FIGURE V-5

FEDERAL GRANTS AS A PERCENTAGE OF STATE AND LOCAL OUTLAYS FOR PUBLIC WORKS



Source: *Trends in Public Works Expenditures, 1960-1984*, a report prepared for the Council by Apogee Research, July 1, 1986. Calculations based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987*, Office of Management and Budget (Washington, DC: Government Printing Office, 1986); *Governmental Finances* (various years), Bureau of the Census, United States Department of Commerce (Washington, DC: Government Printing Office, selected years) and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration; Economic Development Administration; Appalachian Regional Commission; United States Department of Housing and Urban Development; Urban Mass Transit Administration; Federal Highway Administration; United States Army Corps of Engineers; and the Bureau of Reclamation.

Beginning in the mid 1970s, however, the share funded by Federal grant programs increased dramatically. Due primarily to wastewater treatment, transit, and airport projects, the Federal grant share increased to a peak of 53 percent of state and local public works capital investments by 1977. This share declined to about 40 percent in 1982 and has rebounded somewhat since then.

The constant dollar buying power of Federal grants is 91 percent of the high reached in 1978.

Table V-3 presents recent trends in Federal grants to state and local governments for major non-defense physical capital investment.[11] This table shows that, although the total dollar amount of all non-defense public works grants is at its peak now ($26.4 billion), the constant dollar buying power of these grants is only 91 percent of the high reached in 1978. For fiscal 1987, the Administration's budget requests for these programs would reduce that buying power to 81 percent of the peak.

The total is this high mainly because transportation grants, fueled largely by the dedicated highway and airport trust funds, are still growing. Aside from the transportation sector, however, most other Federal public works grants have dropped in value. For example, community and regional development grants are 25 percent below their peak and would be 10 percentage points lower in fiscal 1987 under

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[11] A broad definition of public works is used here as a rough indicator of this type of aid. Because of the aggregated nature of the data sources used, the amounts listed overstate the amount of assistance provided for public works by Federal grants.

TABLE V-3
TRENDS IN FEDERAL GRANTS TO STATE AND LOCAL GOVERNMENT FOR MAJOR NON-DEFENSE PHYSICAL CAPITAL INVESTMENT

(in millions of current dollars)

Program Category	Peak Funding Year	Peak Funding Amount	FY 1986 Funding	FY 1987 Admin Budget Request	% of Peak Funding FY 1986	% of Peak Funding FY 1987
Transportation						
Highways	1986	$13,671	$13,671	$13,172	100%	96%
Transit & RR	1986	3,201	3,201	2,903	100	91
Airports	1981	789	796	828	98	105
Subtotal	1986	17,649	17,649	16,902	100	96
Community & Regional Development:						
Block Grants	1982	4,314	4,063	3,512	94	86
Urban Renewal	1973	1,574	31	0	2	0
Public Works Accel	1978	1,022	0	0	0	0
Other	1975	1,279	793	714	62	56
Subtotal	1979	6,542	4,890	4,226	75	65
Natural Resources & Environment:						
Pollution Control	1980	4,343	2,692	2,514	62	58
Other	1979-81	668	613	562	92	84
Subtotal	1980	4,906	3,305	3,076	72	63
Other Non-Defense:						
Educational & Social Services	1980	297	89	68	30	23
Health	1978	350	0	0	0	0
Other Facilities	1986	249	249	189	100	76
Subtotal	1986	338	338	258	100	76
Total	1986	$26,384	$26,384	$24,462	100%	93%
Total (without transportation)	1980	$10,848	$ 8,735	$ 7,560	80%	70%
Total in 1982 Dollars	1979	$25,762	$23,360	$20,960	90%	81%

Source: Office of Management and Budget, *Historical Tables, Budget of the United States Government, 1987*, Tables 9.1 and 9.5

the President's budget. Pollution control grants now are about two-thirds of their peak, and are proposed to decline further. Federal construction funds for schools and other social service facilities now are only about 30 percent of their peak and proposed to fall to under 25 percent. Direct Federal grants for health facilities no longer are available, although certain other types of Federal funds find their way into this category of investment.

Except for transportation, the Federal government is steadily reducing the relative importance of its public works grant-in-aid programs.

It is quite clear from these figures that, except for transportation, the Federal government is steadily reducing the relative importance of its public works grant-in-aid programs. These programs are funded from the general budget, and are not faring well in the newly intensified competition for budgetary funds.

One other development is worthy of note—the trend toward greater use of block grants. In recent years, the Federal government has enacted a number of new block grants, consolidating large numbers of narrow categorical grants into broader, more flexible programs that give the recipients much greater ability to determine the most suitable spending priorities within their jurisdictions. Most of these grants have been in the fields of health and social services, and education. However, three are in the public works field—one for urban mass transportation and two for community development. In addition, the Administration is supporting proposals for new block grant programs in the highway and pollution control fields. However, there is serious Congressional opposition to these proposals, and the extent to which block grants will affect the public works field remains an open question.

Most of the enacted block grants have been accompanied by reduced funding levels, expanded roles for state governments in determining spending priorities, and reduced roles for state governments in determining spending priorities, and reduced roles for local governments. Evaluations of the existing block grants indicate that the budget cuts often are passed through to beneficiaries, and that state governments generally have done a good job of administration.[15]

b. Cooperative Cost-Sharing Agreements. Similar to grants are Federal projects in which non-Federal cost sharing is required. Water resources projects of the U.S. Army Corps of Engineers and, to a more limited extent, the Bureau of Reclamation illustrate this form of aid.

In former times, these projects were considered to be direct Federal expenditures. State and local contributions were limited to in-kind gifts of land, easements, rights-of-way and other appurtenances, while planning and construction was funded fully by the Federal government. Resulting projects were maintained and operated by state and local governments.

Congress and the Administration have been developing policies under which state and local governments are expected to share planning and construction costs.

Recently, Congress and the Administration have been developing policies under which state and local governments are expected to share planning and construction costs in accordance with agreements negotiated specifically to meet the needs identified in each project. Exactly how these new arrangements will work is still uncertain, but it is clear that state and local roles in determining the nature of such projects will be growing relative to the Federal role.

c. Federal Loans and Loan Guarantees. In addition to direct grants and cooperative agreements, the Federal government subsidizes state and local expenditures through loans and loan guarantees. Loans made directly by the Federal government provide credit for particular undertakings on terms more favorable than otherwise would be available. Federal loan guarantees have a similar effect, but the lenders are private.

As of fiscal 1985, infrastructure loans accounted for 15.8 percent of total direct Federal loans outstanding.

Several *Federal direct loan programs*—including those of the Tennessee Valley Authority, the Economic Development Administration, the Bonneville Power Administration, and the Bureau of Reclamation—provide funds for domestic, non-defense fixed capital programing related to public works.[16] As of fiscal 1985, such programing loans accounted for 15.8 percent of total direct Federal loans outstanding; budget projections for fiscal 1986 and Presidential requests for fiscal 1987 show this share growing to 17.3 percent.

This relative increase, however, reflects slow growth in such loans outstanding (from $40.6 billion in fiscal 1985 to $43.0 billion in fiscal 1987, or about 2.9 percent per year) coupled with a decline in total loans outstanding for all purposes (from $257.4 billion to $248.9 billion). Moreover, the changes slated for fiscal 1985 to fiscal 1987 differ markedly from those experienced between fiscal 1982 and fiscal 1985. In that earlier period, public works loans outstanding increased at an average annual rate of 45.7 percent.[17]

The significance of Federal direct loans in domestic, non-defense fixed capital finance can be seen by looking at magnitudes other than loans outstanding, which reflect the cumulative effects of several years' policies. Three other measures provided in Table V-4 are obligations for new loans, actual loan disbursements, and changes in loans outstanding; the last of these reflects both new disbursements and repayments on earlier loans.

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[15] A thorough analysis of Federal aid trends and their economic effects is provided by The Office of State and Local Finance, U.S. Department of Treasury, *Federal-State-Local Fiscal Relations* (Washington, DC: U.S. Government Printing Office, 1985).

[16] A broad definition of public works is used here as a rough indicator of this type of aid. Because of the aggregated nature of the data sources used, the amounts listed overstate the amount of assistance provided for public works by loans and loan guarantees.

[17] Nearly three-quarters of the increase in outstanding direct Federal loans from 1982 to 1985 is attributable to the Department of Agriculture's Rural Development Insurance Fund and its Rural Electrification and Telephone Administration.

TABLE V-4
FEDERAL DIRECT LOANS FOR DOMESTIC NON-DEFENSE PUBLIC WORKS*
(In Millions of Current Dollars)

Agency or Program	Program Measure	1982 Actual	1985 Actual	1986 Est	1987 Request
AGRICULTURE					
Rural Development Insurance Fund	Obligations	$1,043	$455	$421	$0
	Loan Disbursements	1,497	531	478	415
	Changes in Outstandings	−132	375	309	141
	Outstandings	447	7,708	8,016	8,158
COMMODITY CREDIT CORP					
Storage Facility Loans	Obligations		1		0
	Loan Disbursements		1		0
	Changes in Outstandings		−318	−264	−105
	Outstandings		398	134	29
Rural Electrification and Telephone	Obligations	1,284	2,231	2,196	1,954
	Loan Disbursements	1,160	2,136	2,108	1,892
	Change in Outstandings	237	1,331	1,117	1,273
	Outstandings	10,947	26,782	27,899	29,172
COMMERCE					
Economic Development Revolving Fund	Obligations	18	93	21	16
	Loan Disbursements	101	101	24	16
	Changes in Outstandings	−104	7	−49	−38
	Outstanding	890	631	582	544
EDUCATION					
Higher Education Facilities	Obligations		0	0	0
	Loan Disbursements		0	0	0
	Changes in Outstandings	—	−19	−17	−17
	Outstandings		356	339	322
ENERGY					
Bonneville Power Administration	Obligations			20	20
	Loan Disbursements			20	20
	Changes in Outstandings		4	19	18
	Outstanding		6	24	42
HEALTH & HUMAN SERVICES					
HMOs and Medical Facilities	Obligations		2	2	2
	Loan Disbursements		3	3	2
	Changes in Outstandings		−19	−9	−10
	Outstandings		259	251	241
HOUSING & URBAN DEVELOPMENT					
Community Development Loans	Obligations		133	50	0
	Loan Disbursements		103	108	73
	Changes in Outstandings		81	46	0
	Outstandings		289	335	335
INTERIOR					
Reclamation	Obligations		33	46	46
	Loan Disbursements		58	48	49
	Changes in Outstandings		31	38	40
	Outstandings		442	480	520
TRANSPORTATION					
Railroad Rehab. and Improvement	Obligations	44	19	4	0
	Loan Disbursements	63	13	14	10
	Changes in Outstandings	55	2	−81	3
	Outstandings	569	720	639	641
Federal Aid Highways & Right-of-way	Obligations		77	48	51
	Loan Disbursements		55	49	51
	Changes in Outstandings		−9	−1	1
	Outstandings		191	188	189

(continued)

TABLE V-4 (continued)
FEDERAL DIRECT LOANS FOR DOMESTIC NON-DEFENSE PUBLIC WORKS*
(In Millions of Current Dollars)

Agency or Program	Program Measure	1982 Actual	1985 Actual	1986 Est.	1987 Request
ENVIRONMENTAL PROTECTION AGENCY					
Abatement, Control, and Compliance	Obligations		$31	$32	$2
	Loan Disbursements		2	30	31
	Changes in Outstandings		2	30	30
	Outstandings		2	32	62
NASA					
Space Flight, Control, and Data Comm.	Obligations		0	0	0
	Changes in Outstandings		-67	0	-79
	Outstandings		888	888	809
SMALL BUSINESS					
Small Business Devel. Co.'s	Changes in Outstandings		-7	-10	-10
	Outstandings		33	23	13
TENN. VALLEY AUTHORITY	Obligations	$77	269	314	236
	Loan Disbursements	76	269	314	236
	Changes in Outstandings	66	94	135	-151
	Outstandings	267	1,915	2,049	1,898
TOTAL FOR PUBLIC WORKS	Obligations	$2,492	$3,356	$3,154	$2,327
	Loan Disbursements	2,897	3,272	3,196	2,795
	Changes in Outstandings	120	1,500	1,263	1,096
	Outstandings	13,121	40,018	41,880	42,975
TOTALS FOR ALL PURPOSES	Obligations	47,330	52,847	41,634	30,555
	Loan Disbursements	28,640	64,396	47,327	34,440
	Changes in Outstandings	23,452	27,991	(4,076)	(4,381)
	Outstandings	207,006	257,166	253,209	248,900
PERCENTAGE OF TOTAL FOR PUBLIC WORKS	Obligations	5.2%	6.4%	7.6%	7.6%
	Loan Disbursements	10.1%	5.1%	6.8%	8.1%
	Changes in Outstandings	0.5%	5.4%	31.0%	-25.0%
	Outstandings	6.3%	15.6%	16.5%	17.3%

* A broad definition of public works is used here as a rough indicator of this type of aid. Because of the aggregated nature of the data sources used, the amounts listed overstate the amount of assistance provided for public works by direct loans.

Source: U.S. Office of Management and Budget, *Special Analyses, Budget of the U.S. Government, Fiscal Year 1987*, Table F-19, and Fiscal Year 19[illegible], Table F-6.

outstanding; the last of these reflects both new disbursements and repayments on earlier loans.

In fiscal 1982, Federal these non-defense fixed-capital public works loans outstanding increased by only $120 million, but the fiscal 1985 increase was $1.5 billion; by fiscal 1987 the figure is expected to drop back to about $1.1 billion. New obligations for such loans, which grew from $2.5 billion in fiscal 1982 to $3.4 billion in fiscal 1985, would drop to $2.3 billion in fiscal 1987 if the President's budget request is enacted. Loan disbursements, also in the $2 billion to $3 billion range, increased to 1985, but are projected to decline thereafter. Thus, regardless of the measure, public works finance is not a significant target for Federal loans, and this trend is expected to shrink even further in the next few years.

Federally guaranteed loans are agreements in which the Federal government guarantees the repayment of the principal and interest, in whole or in part, for certain types of loans from private sources.

TABLE V-5
FEDERAL LOAN GUARANTEES FOR DOMESTIC NON-DEFENSE PUBLIC WORKS*
(In Millions of Current Dollars)

Agency or Program	Program Measure	1982 Actual	1985 Actual	1986 Est.	1987 Request
AGRICULTURE					
Rural Electrification Administration	Commitments	$7,680	$0		
	New Guaranteed Loans	4,223	147	$140	$140
	Changes in Outstandings	4,381	115	128	128
	Outstandings	20,325	1,045	1,173	1,301
Rural Development Insurance Fund	Commitments	3,674	63	96	0
	New Guaranteed Loans	3,950	176	226	137
	Changes in Outstandings	1,049	−298	−223	−156
	Outstandings	[illegible]	2,912	2,689	2,533
COMMERCE					
Economic Development Revolving Fund	Commitments	14	0	0	0
	New Guaranteed Loans	14	0	0	0
	Changes in Outstandings	[illegible]	−172	−25	−40
	Outstandings	[illegible]	235	210	170
HEALTH & HUMAN SERVICES					
HMOs and Medical Facilities	Commitments		0	0	0
	New Guaranteed Loans		0	0	0
	Changes in Outstandings		−91	−63	−66
	Outstandings		995	932	865
TENN. VALLEY AUTHORITY	Commitments	[illegible]	0	0	0
	New Guaranteed Loans	[illegible]	0	0	0
	Changes in Outstandings	[illegible]	0	0	0
	Outstandings	[illegible]	1	1	1
TOTAL FOR PUBLIC WORKS	Commitments	[illegible]	$63	$96	$0
	New Guaranteed Loans	[illegible]	323	366	277
	Changes in Outstandings	[illegible]	[illegible]	−183	−134
	Outstandings	[illegible]	5,188	5,005	4,870
TOTAL FOR ALL PURPOSES	Commitments	[illegible]	[illegible]	90,850	79,768
	New Guaranteed Loans	[illegible]	[illegible]	73,570	68,187
	Changes in Outstandings	[illegible]	[illegible]	40,174	30,796
	Outstandings	[illegible]	410,442	450,616	481,412
PERCENTAGE OF TOTAL FOR PUBLIC WORKS	Commitments	[illegible]	0.1%	0.1%	0.0%
	New Guaranteed Loans	[illegible]	0.4%	0.5%	0.4%
	Changes in Outstandings	[illegible]	[illegible]	−0.5%	−0.4%
	Outstandings	[illegible]	1.3%	1.1%	1.0%

* A broad definition of public works is used here as a rough indicator of this type of aid. Because of the aggregated nature of the data sources used, the amounts listed overstate the amount of assistance provided for public works by direct loans guarantees.

Source: U.S. Office of Management and Budget, *Special Analyses, Budget of the U.S. Government, Fiscal Year 1987*, Table F-20, and Fiscal Year 1984, Table F-9.

Federally guaranteed loans for infrastructure amounted to just over $5 billion in 1985, 1.2 percent of such guarantees outstanding.

Loan guarantees are used for a variety of programs, and provide commitments to individuals and businesses as well as to state, local, and foreign governments. The overwhelming majority of loan guarantees go to support individuals and businesses (for housing, student loans, export promotion, and small business ventures). State and local governments are minor beneficiaries, particularly with respect to support for public works activity. Indeed, as Table V-5 shows, guarantees for such projects amounted to just over $5 billion in 1985, or only 1.2 percent of the total Federal loan guarantees outstanding.

Clearly, the use of Federal loan guarantees to finance public works is a minor and (as the table indicates) declining factor in state and local infrastructure development.

The public works portion of Federal tax expenditures is relatively small and shrinking.

d. *Federal Tax Expenditures.* Special Analysis G of the U.S. Budget estimates foregone tax revenues because of special exclusions, exemptions or deductions allowed under the Internal Revenue Code to encourage certain types of investment by individuals and corporations. While these tax expenditures span a variety of programs, several are related to public works financing.

In general, tax expenditures have been growing.[18] The public works portion, however, is relatively small and shrinking compared to credits or deductions for income security, business and housing credit, and health. New tax legislation is expected to result in substantial reductions in the amount of such tax expenditures, as calculated by the Federal government.

State aid to local governments for public works . . . is about $7.5 billion per year . . . and is administered through approximately 325 programs.

e. *State Aid to Local Governments.* State aid to local governments for public works, although only about one-third the amount of Federal grants for these purposes, is substantial. It consists mostly of grants and revenue sharing, and amounts to about $7.5 billion per year. This assistance is administered through approximately 325 programs that aid infrastructure construction, maintenance, and repair. The aid provided by these programs, however, has not increased in recent years by an amount that would offset Federal aid reductions.

As Table V-6 shows, 86 percent of state aid for public works goes for transportation (mostly highways), and about 8 percent goes for water supply, wastewater, and flood control functions. The remaining 6 percent is divided among solid waste, energy, natural resources, parks and recreation, utility, community development, and other programs. Thus, state aid for capital investment is weakest in those fields where Federal aid is declining or non-existent.

Detailed information about these state programs is not readily available. It is known, however, that generally they have been used more to return funds to their source rather than to achieve fiscal equalization. Under that concept, the state returns revenues to the local jurisdictions where funds are collected, rather than to the jurisdictions where funds might be needed most.

In addition to providing outright grants, a number of states have become important innovators in infrastructure finance in an effort to raise needed revenue. Among the techniques being tried are state revolving loan funds, bond banks, dedication of some portion of lottery proceeds to public works, interest write downs on local public works debt, grants for local debt service, low interest loans to localities, purchase of local debt obligations, and loan guarantees.

A number of states have become important innovators in infrastructure finance.

One way to respond to financial stress is to consider low-cost alternatives to major new construction projects. States have begun to experiment with such measures based upon a decade of experience in the Federal Aid Highway Program. This concept now appears to be finding its way into other Federal and state programs. For example, regulatory reform studies over the past decade have stressed the government-wide need to give states and localities flexibility in complying with Federal regulations. These studies have spawned new, less costly alternatives in EPA's air and water quality programs. The

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[18] U.S. Department of Treasury, *Federal-State-Local Fiscal Relations,* Chapter VI-C and Chapter IX. State and local governments also subsidize the Federal government and its quasi-independent agencies through a variety of devices such as the exemption of Federally owned property from local property taxes. For a further discussion of this type of subsidy see *Federal-State-Local Fiscal Relations* Chapter X, and U.S. Advisory Commission on Intergovernmental Relations, *Payments In Lieu of Taxes on Federal Real Property,* 2 volumes (Washington, DC: U.S. Government Printing Office, 1981).

TABLE V-6
STATE AID FOR PUBLIC WORKS, 1982

Public Works Mode	# States with Programs	# Programs	Amount (Thousands)	% of Total Amount
Transportation:				
Hwy, Roads & Bridges	48	157	$5,442,834	(72%)
Transit	18	25	872,559	
Railroads	1	1	349	
Ports and Waterways	3	11	49,692	
Airports	37	42	92,799	
Subtotal	48	238	6,457,233	86%
Water:				
Sewerage	31	33	528,735	
Water Supply	14	16	88,116	
Water Pollution Control	2	2	19,644	
Flood Control	10	10	3,008	
Subtotal	38	61	639,503	8%
Solid Waste	8	8	4,342	*
Energy	2	2	9,479	*
Natural Resources Conservation	3	3	3,287	*
Utilities	1	1	13,153	*
Community Development	2	2	17,494	*
Other	9	12	375,157	5%
TOTAL	50	327	$7,519,448	100%

* Less than 0.5%

Source: U.S. Bureau of the Census, *1982 Census of Governments: State Payments to Local Governments*, Topical Studies, Vol. 6, No. 3 (Washington, DC: U.S. Government Printing Office, October 1984).

Federal lessons might point the way toward redesigning state aid programs.

idea is to make better use of existing facilities or to take fuller advantage of existing circumstances. Such goals might be accomplished by spreading demand over a longer period of time, by making minor physical and operational improvements that would increase capacity significantly, or by recognizing that full "letter-of-the-law" compliance might not be justifiable under certain conditions. These Federal lessons might point the way toward redesigning state aid programs as the states take on increasing responsibilities across a broad range of public works activities.

Much more needs to be known about state aid programs in the public works field before recommendations can be made about remolding state role.

Tax-Exempt Debt.[19] Because long construction periods precede even lohger periods over which many types of capital assets provide benefits, debt financing of initial outlays often is preferable to pay-as-you-go financing. Debt repaid concurrent with the use of the capital asset makes it much more likely that those who receive the benefits will be those who pay for them, this enhances not only efficiency, but also equity among generations. For public works at the state or local level, where the population changes even within a generation, debt financing is often appropriate.

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[19] This section draws on two reports prepared for the National Council on Public Works Improvement: Clare Delmar and Aurelio Menendez, "Infrastructure Finance in the United States: Issues and Mechanisms," and Ronald Forbes, "Governmental Debt Financing of Public Works."

The advantages of debt financing are greater for large and infrequent capital outlays; they may be diminished for activities that require a smoother flow of smaller capital outlays over time. Water supply reservoirs, sewage treatment plants, and most highway and subway construction are major one-time projects, although smooth capital outlay flows of a smaller magnitude, such as periodic replacement of subway cars and resurfacing of streets and roads, usually follow.

The post-1978 decline in constant dollar Federal aid may make the bond market a more important source of capital to state and local government.

Another important feature of state and local debt for both borrowers and lenders has been exemption of interest from Federal taxation. The post-1978 decline in constant dollar Federal aid may make the bond market, both tax-exempt and taxable, a more important source of capital to state and local governments, even though the relative cost of that capital may increase because of prospective changes in Federal tax law.

The proportion of infrastructure financed with the proceeds of long-term state and local bonds fluctuates widely. Some, but not all, of this fluctuation may be explained by movements in nominal interest rates. For example, available data[20] suggest that in the late 1950s, almost half of all state and local public works facilities were financed with long-term bonds. Although some large year-to-year fluctuations have been due to changing interest rates and other economic and institutional factors, the share of public works financed with debt in recent years fell steadily from nearly 60 percent in the early 1970s to about 22 percent in 1980. Most recently, long-term debt has accounted for about 40 percent of all state and local public works outlays.

Own Source Receipts. State and local taxes and fees account for the remainder of public works financing. Sometimes these sources are dedicated to public works, while in other instances public works are paid for out of the general fund.

State and local governments may need to use own source revenues to fund larger proportions of public works in the future.

The major "own source" revenues for state and local governments that may be used for public works are general sales taxes (16.9 percent of total own source revenues in 1984), the property tax (21.6 percent), individual and corporate income taxes (18.3 percent), and user charges and fees, plus miscellaneous sources such as special assessments (28.2 percent). Given the general declines in intergovernmental aid and potential increases in the cost of debt financing as a result of Federal tax-reform legislation, state and local governments may need to use own source revenues to fund larger proportions of public works in the future. Therefore, more information must be developed on the capacity of general revenue sources to fund infrastructure expenditures.

Alternative Mechanisms

In the context of the preceding review of existing sources of funding for public works, this section examines some debt and "non-debt" alternatives to the traditional tools employed by states and localities. This state and local focus is appropriate for two reasons. First, state and local governments now pay for more than half of all government public works capital outlays, and may pay for an even larger share in the future. Second, many concerns about debt are focused at the state and local level. In addition, innovative alternatives to traditional debt and non-debt financing techniques are used almost exclusively by state and local governments.

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[20] Apogee Research, "Trends in Financing Public Works, 1960-1984," a paper prepared for the National Council on Public Works Improvement, July 1986 which draws on *A Study of Public Works Investment in the United States*, CONSAD Research Corp. 1980.

Alternatives to traditional financing have emerged and may become more important in the future because of:

Alternatives to traditional financing have emerged.

- disruption of bond markets, with relatively high and volatile interest rates in recent years;
- voter resistance to approval of bond issues;
- Federal tax law changes, both historic and prospective, that alter the nature of the state and local bond market; and
- resistance to tax increases by taxpayers and officials.

The basic purpose of recent innovations has been to reduce the interest rates governments must pay while continuing to give them access to changing capital markets.

Debt Innovations. Several innovations in state and local debt have been prompted, in part, by the developments noted above, principally high and fluctuating tax-free interest rates and tax reform proposals. The basic purpose of recent innovations has been to reduce the interest rates that governments must pay while continuing to give them access to changing capital markets. This has been accomplished in several ways, including development of new debt instruments such as variable-rate demand bonds and pooled financing and bond banks, which are described below.[21]

Variable-rate demand bonds carry shorter-term interest rates (1-365 day) than traditional long-term bonds, and have been made more attractive to lenders by inclusion of such new features as (1) a demand option, which permits investors to redeem their holdings at par at selected intervals; (2) an interest rate pegged to current short-term rates in the tax-exempt market; and (3) a back-up source of credit enhancement to increase investor confidence and acceptance (such as bond insurance and bank letters of credit). These features also assist borrowers by permitting higher credit ratings where credit enhancement is used.

Pooled financing and bond banks give smaller borrowers, in particular, access to lower interest rates by enabling them to participate in larger debt issues and to enjoy the better yields that often attend increased size and market visibility. Several states have established pooled financing for their local governments. In several other countries, special infrastructure banks or funds have been created with the same end in mind; such a fund also has been proposed for the United States. These funds may feature a legislative appropriation to supplement or substitute for borrowed funds.

Tax-exempt leases [have] advantages to state or local governments including the avoidance of bond referenda, debt ceilings, and procedural delays.

Tax-exempt leases, or lease purchases, feature public ownership and public users, and in essence are a form of public debt (although technically they do not fall into that category). A lease is sold to a private financial institution or syndicate, which then becomes the nominal lessor and receives principal and interest through the lease payments; the interest portion of these payments from the state or local lessee is tax exempt. Possible advantages to state or local governments include the avoidance of bond referenda, debt ceilings, and procedural delays.

Non-Public Debt Techniques. Some of the same developments that have prompted innovation in the debt market also have spawned entirely new approaches to direct capital investment.[22] These approaches, often collectively termed "privatization," are cooperative arrangements between the public and private sectors in the provision of public services. Generally, they avoid the use of public debt, at least technically, by substituting private debt or equity. They are of three general types: (1) leasing; (2) contracting for services; and (3) bargaining between the public sector and private developers for private provision of public infrastructure. Potentially, they are mutually advantageous arrangements, offering the public sector access to lower-cost capital assets and services through construction savings and operating efficiencies, and producing profits for the private participants.

Approaches, often collectively termed "privatization," avoid the use of public debt . . . by substituting private debt or equity.

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[21] For a detailed discussion see Forbes, "Governmental Debt Financing," *op. cit.*

[22] For a detailed discussion of non-debt financing techniques see John Petersen, James Mallory, Lawrence Pierce and Barbara Weiss, "Non-Debt Financing of Public Works Facilities," a paper prepared for the National Council on Public Works Improvement, July 1986.

"True" leases involve private ownership of a facility leased to the public; the chief tax benefit is depreciation, which is of value to a private owner, but not to a (non-taxable) public owner. Accelerated depreciation schedules may be used when facilities are financed privately, but straight-line depreciation must be used for facilities financed by tax-exempt securities.

Special service contracts entail private financing, ownership, and use of capital facilities, with services provided to the public under contract. Accelerated depreciation, investment tax credits, and tax-exempt interest rates all have been available under this arrangement, although these are expected to be eliminated or severely restricted by prospective changes in Federal tax law.

Bargaining between public officials and private developers . . . provides public facilities with no outlay of public funds.

Less dependent upon tax benefits, and less widely used than the two approaches discussed above, is bargaining between public officials and private developers. In essence, this approach provides public facilities with no outlay of public funds for acquisition. As a condition of the issuance of development permits, the government secures the developer's agreement to provide certain facilities—such as streets, sewers, parks, parking lots, and schools—to government specification. Developers, in agreeing to these terms, imply that it is preferable to accept such conditions than to forego development.

At least two observations about this process are appropriate. First, such agreements are thought to work best in rapidly growing areas, where development is important and various developers may be competing for the right to develop. The technique may be less relevant in restoring deteriorating facilities, or in providing new facilities in more settled or deteriorating areas. Second, bargaining necessarily is case-specific, but governments may need to legislate a general framework to better establish the legality of exactions from developers (California, for example, adopted such a statute in 1979).

Tax Reform and Infrastructure Finance

Tax legislation currently before Congress will have a significant impact on many of the innovations discussed above, as well as others now used by state and local governments to finance infrastructure, although the precise consequences cannot be predicted at this time. For example, the legislation alters the test for determining when bonds qualify as industrial development bonds (IDBs). Many types of tax-exempt bonds often used in the past to finance public works will become subject to more stringent restrictions applicable to IDBs. In particular, these restrictions include tightened volume limitations, which will make it more difficult for certain projects to compete with one another for financing allocations in each state. In addition, a new requirement that arbitrage earnings (or the difference between the yield on tax-exempt bonds and the yield on investments in taxable instruments made with the proceeds of such bonds) be turned over to the Federal government will make bond-financed projects more costly than before. The legislation also will change the economics of various forms of privatization, not only because of the additional restrictions on bond financing, but also because of the elimination of investment tax credits and a rescheduling of depreciation deductions.

Given the potential loss of Federal tax benefits, all privatization alternatives will have to be evaluated carefully on their economic merits.

Given the potential loss of Federal tax benefits, all privatization alternatives will have to be evaluated carefully on their economic merits. More information must be developed on these alternatives to determine the specific conditions that may increase efficiency and reduce costs.

Concluding Comment

This review of infrastructure expenditure and finance trends and tools shows the critical and growing importance of the role of state and local governments in funding public works outlays (for both capital as well as operating and maintenance purposes).

This finding is not surprising, in view of the fact that it has been national policy since the late 1970s to decentralize fiscal responsibility for domestic (non-defense) spending.

Thus, in a departure from some previous infrastructure studies that focused largely on the importance of the Federal role in public works and the fine tuning of national "needs" assessments, the Council will put added emphasis where future action is most likely to be—namely, at the state and local levels. State and local issues of importance include more effective use of tax-exempt bonds, the potential for taxable bonds, use of general revenues, new user fees and tolls, privatization, and the appropriate use of special purpose districts. These issues will be examined in detail in Report II.

Chapter VI Conclusions

The intention of the National Council on Public Works Improvement is to spark interest and participation among institutions and individuals who will continue a long-term coordinated strategy to renew and expand the nation's infrastructure. To this end, the Council has begun its work with the premise that the infrastructure issue has to be translated from the abstraction of numbers into the human experience of elected officials and managers who confront difficult public works decisions every day.

Overarching the discussion of issues in this first report is the challenge of closing the gap between available resources and perceived needs, neither of which are fixed for any jurisdiction at any given time. To address this challenge realistically, the Council believes it is essential to examine changing relationships within the federal system, decision-making and management practices, technological opportunities, and financing options, as well as methods to assess needs.

The Council believes it is essential to examine changing relationships within the federal system.

Public works needs studies undertaken since the 1970s have helped build public awareness about physical infrastructure systems. While these studies constituted the first broad attempt to define and categorize national infrastructure needs, the Council believes that the criteria and procedures used to assess public works requirements should be reevaluated. A number of issues are involved in this process, including consideration of the concept of need in the context of spending priorities, the variability of need in relation to standards for infrastructure improvement, the existence and effect of new construction biases, the impact of benefit-cost analysis on the definition of need, and the question of whether needs should be defined in terms of current or future capacity requirements.

Public works needs . . . criteria and procedures . . . should be reevaluated.

Identification of need is only one facet of the infrastructure challenge. How to deal effectively with need is at least as important an issue. This subject must be addressed not only by Federal, state, and local government officials and public works managers, but also by the public at large, which supports infrastructure improvements through taxes, fees, and other payments.

Over the years, the roles of governments and the private sector have shifted, albeit not in a continuous pattern. As discussed in this report, the role of the Federal government in financing infrastructure improvements has changed markedly in recent times. Changes in the relative involvement of Federal, state, and local governments in planning and financing infrastructure improvements require reevaluation of the decision-making processes, and of the responsibilities of each level of government. Many state and local governments have responded to these changes by soliciting increased participation by the private sector in areas traditionally viewed as governmental.

The Council intends to examine potential improvements in . . . decision support systems.

In conjunction with the shifting roles of governments, additional attention has focused on the need for improved political leadership and management practices in the public works field. Great strides have been made over time in developing a professional cadre of public works managers. Nevertheless, the profession will face dramatic new challenges in the future. In Reports II and III, the Council intends to examine potential improvements in this area, including the use of computer-assisted decision support systems, intergovernmental coordination techniques, dispute prevention and resolution techniques, reformulated community planning processes, and effective capital improvement programming and budgeting.

Technological innovation represents a potential means of meeting the nation's infrastructure requirements in a more efficient and less costly manner. New technologies can provide better construction materials and more reliable systems for planning, designing, and monitoring public works facilities.

Technological advances in the infrastructure field are possible.

Research programs for defense, space exploration and medicine —where strong national commitments have been made—show that science can produce dramatic results in a reasonably short time. Similar technological advances in the infrastructure field are possible if a focused and vigorous research effort were to provide the spark and buffer the risks. Such advances should be encouraged. The Council intends to explore means of stimulating and communicating such advances in its next reports.

The Council will explore . . . different sources of financing for infrastructure.

Finally, but not least important, the Council will explore infrastructure-related financing issues in greater depth in Reports II and III. This will involve a general examination of spending priorities and resource allocations, as well as more technical questions relating to financing mechanisms. Clearly, as financing responsibilities shift from Federal to state and local governments, different sources of financing for infrastructure improvement must be found.

Appendix A

PUBLIC WORKS IMPROVEMENT ACT OF 1984

Public Law 98-501
98th Congress

An Act

Oct. 19, 1984
[S. 1330]

To establish a National Council on Public Works Improvement to prepare three annual reports on the state of the Nation's infrastructure, to amend the provisions of title 31, United States Code, relating to the President's budget to require it to separately identify and summarize the capital investment expenditures of the United States, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Public Works Improvement Act of 1984.

TITLE I—NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

SHORT TITLE

42 USC 3121 note.

Sec. 101. This title may be cited as the "Public Works Improvement Act of 1984".

ESTABLISHMENT

42 USC 3121 note.

Sec. 102. There is established a council to be known as the National Council on Public Works Improvement (hereinafter in this title referred to as the "Council").

DUTIES

Report.
42 USC 3121 note.

Sec. 103. (a)(1) Not later than February 15, 1986, February 15, 1987, and February 15, 1988, the Council shall prepare and submit to the President and the Congress a report on the state of the Nation's infrastructure (hereinafter in this title referred to as the "Infrastructure Report"). Each Infrastructure Report shall include, but not be limited to, an analysis of each of the following:

(A) the age and condition of public works improvements and changes in their condition from preceding years;

(B) the methods used to finance the construction, acquisition, rehabilitation, and maintenance of public works improvements, including but not limited to general obligation and revenue bonds, user fees, excise taxes, direct governmental assistance, and private investment;

(C) any trends in methods used to finance such construction, acquisition, rehabilitation, and maintenance;

(D) the capacity of public works improvements to sustain current and anticipated economic development and to support a sustained and expanding economy;

(E) maintenance needs and projected expenditures for public works improvements.

(2) In addition, each Infrastructure Report—

(A) shall include a discussion of infrastructure program priorities (including alternative methods of meeting national infrastructure needs to effectuate balanced growth and economic development); and

(B) to the extent practicable, shall provide, for other public works facilities owned or operated by the Federal Government, any State or local government, or any public agency or authority organized pursuant to State or local law, an analysis similar to the analysis provided under paragraph (1) for public works improvements.

(b) Not later than September 30, 1985, the Council shall—

(1) analyze criteria and procedures used by Federal agencies, States, and units of local government in inventorying existing and needed public works improvements and assessing the condition of public works improvements and develop and publish uniform criteria and procedures which may be used for conducting such inventories and assessments; and

(2) develop and recommend to the President and the Congress proposed guidelines for the uniform reporting by Federal agencies of construction, acquisition, rehabilitation, and maintenance data with respect to public works improvements.

(c) The Council shall convene its first meeting no earlier than February 15, 1985, and no later than April 15, 1985.

(d) In carrying out its duties under this section, the Council shall use existing data and sampling techniques to the maximum extent feasible. When developing new data under this title, the Council shall make every effort to assure that such data is developed in consultation with the States so that uniform methods, categories, and analyses are used.

(e) Each Infrastructure Report, when submitted to the Congress, shall be referred to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate.

MEMBERSHIP

SEC. 104. (a) The Council shall be composed of five members— 42 USC 3121 note.

(1) three of whom shall be appointed by the President;

(2) one of whom shall be appointed by the Speaker of the House of Representatives; and

(3) one of whom shall be appointed by the President pro tempore of the Senate;

from among persons knowledgeable and experienced in one or more of the following: public administration, planning, architecture, civil engineering, and public investment financing.

(b) A vacancy in the Council shall not affect its powers but shall be filled in the manner in which the original appointment was made.

(c) Four members of the Council shall constitute a quorum, but the Council may establish a lesser number as a quorum for the purpose of holding hearings, taking testimony, and receiving evidence.

(d) The Chairman of the Council shall be elected by the members of the Council.

(e) The Council shall meet at the call of the Chairman or a majority of its members.

(f) Members of the Council shall be appointed for the life of the Council.

(g) Members of the Council shall serve without pay, except that they shall receive per diem and travel expenses in accordance with section 5703 of title 5, United States Code.

DIRECTOR AND STAFF

42 USC 3121 note

SEC. 105. (a) The Council shall have a director who shall be appointed by the Council and shall be paid at a rate not to exceed the rate of basic pay payable to level V of the Executive Schedule.

(b) The Council may appoint and fix the pay of such additional personnel as the Council considers appropriate.

5 USC 5101 *et seq.*, 5331

5 USC 5332 note

(c) The director and staff of the Council may be appointed without regard to the provisions of title 5, United States Code, governing appointments in the competitive service and may be made without regard to the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates. Any Federal employee subject to the civil service laws and regulations who may be employed by the Council shall retain civil service status without interruption or loss of status or privilege. In no event shall any employee of the Council other than the staff director receive as compensation an amount in excess of the maximum rate of basic pay payable for GS-18 of the General Schedule.

POWERS OF THE COUNCIL

42 USC 3121 note

SEC. 106. (a) Upon request of the Council, the head of any Federal agency may detail, on a reimbursable basis, any of the personnel of such agency to the Council to assist the Council in carrying out its duties under this title.

(b) Upon request of the Council, the Secretary of the Army, acting through the Chief of Engineers, shall provide, on a reimbursable basis, such office space, supplies, equipment, and other support services to the Council and its staff as may be necessary for the Council to carry out its duties under this title.

(c) The Council may secure directly from any department or agency of the United States information necessary to enable it to carry out this title. Upon request of the Chairman of the Council, the head of such department or agency shall furnish such information to the Council.

Contracts with U.S.

(d) The Council or any member authorized by the Council may, for the purpose of carrying out this title, hold such hearings, sit and act at such time and places, take such testimony, have such printing and binding done, enter into such contracts and other arrangements (with or without consideration or bond, to such extent or in such amounts as are provided in appropriation Acts, and without regard to section 3709 of the Revised Statutes (41 U.S.C. 5)), make such expenditures, and take such other actions as the Council or such member may deem advisable to carry out this title. Any member of the Council may administer oaths or affirmations to witnesses appearing before the Council or before such member.

ADVISORY GROUP

Establishment
42 USC 3121 note

SEC. 107. (a) There is established an advisory group to provide such assistance and advice as the Council may request. Such group shall be composed of 12 members as follows:

(1) the Secretary of the Army, who shall be the Chairman of such group;

(2) the Secretary of Agriculture;

(3) the Secretary of Housing and Urban Development;

(4) the Secretary of Transportation;

(5) the Administrator of the Environmental Protection Agency;

(6) the Secretary of Commerce;

(7) the Chairman of the National Governors Association;

(8) the President of the National Conference of State Legislatures;

(9) the President of the National Association of Counties;

(10) the President of the National Association of Regional Councils;

(11) the President of the National League of Cities; and

(12) the President of the United States Conference of Mayors.

(b) The members of the advisory group shall serve without pay.

Termination.

(c) The advisory group shall cease to exist on April 15, 1988.

CONGRESSIONAL BUDGET OFFICE REVIEW

Report
42 USC 3121 note

SEC. 108. Not later than 90 days after the date on which each Infrastructure Report is submitted to the Congress by the Council, the Congressional Budget Office shall review such report and shall submit a report on the results of such review to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate.

TERMINATION

42 USC 3121 note

SEC. 109. The Council shall cease to exist on April 15, 1988.

FUNDING

42 USC 3121 note

SEC. 110. (a) From funds otherwise appropriated to the Secretary of the Army for purposes of civil works, the Secretary shall transfer to the Council in the fiscal year ending September 30, 1985, such amounts as the Council may request but not to exceed $3,200,000.

Appropriation authorization.

(b) There is authorized to be appropriated to the Council to carry out the provisions of this title $3,500,000 per fiscal year for each of the fiscal years ending September 30, 1986, and September 30, 1987, and $2,000,000 for the fiscal year ending September 30, 1988.

DEFINITIONS

42 USC 3121 note

SEC. 111. For purposes of this title, the term—

(1) "acquisition" includes the addition of land, sites, equipment, structures, facilities, or rolling stock by purchase, lease-purchase, trade, or donation;

(2) "construction" includes the design, planning, and erection of new structures and facilities, the expansion of existing structures and facilities, the reconstruction of a project at an existing

site or adjacent to an existing site, and the installation of initial and replacement equipment for such structures and facilities;

(3) "public works improvements" means the following publicly owned civilian facilities: highways; streets; bridges; mass transportation facilities and equipment; resource recovery facilities; airports; airway facilities; water supply and distribution systems; wastewater collection, treatment, and related facilities; dams; federally owned buildings; docks and ports; waterways; and such other public facilities as the Council determines are critical for national economic development;

(4) "maintenance" means regularly scheduled activities, including routine repairs, intended to keep a facility operating efficiently; and

(5) "rehabilitation" includes the alteration of or correction of deficiencies in an existing structure or facility so as to extend the useful life or improve the effectiveness of the structure or facility, the modernization or replacement of equipment at an existing structure or facility, and the modernization of, or replacement of parts for, rolling stock.

Federal Capital Investment Program Information Act of 1984.

TITLE II—FEDERAL CAPITAL INVESTMENT PROGRAM

SHORT TITLE

31 USC 1101 note.

SEC. 201. This title may be cited as the "Federal Capital Investment Program Information Act of 1984".

PURPOSES

31 USC 1105 note.

SEC. 202. The purposes of this title are—

(1) to provide budget projections for major Federal capital investment programs;

(2) to provide a summary of the most recent needs assessment analyses for these programs;

(3) to provide information on the sensitivity of the needs estimates to major policy issues and technical and economic variables;

(4) to assist the planning capabilities of State and local governments on the assessment of major capital investment programs; and

(5) to improve legislative oversight over Federal capital investment programs.

FEDERAL CAPITAL INVESTMENT PROGRAM REPORT

SEC. 203. Section 1105 of title 31, United States Code, is amended by adding at the end thereof the following new subsection:

"(e)(1) The President shall submit with materials related to each budget transmitted under subsection (a) on or after January 1, 1985, an analysis for the ensuing fiscal year that shall identify requested appropriations or new obligational authority and outlays for each major program that may be classified as a public civilian capital investment program and for each major program that may be classified as a military capital investment program, and shall contain summaries of the total amount of such appropriations or new obligational authority and outlays for public civilian capital investment programs and summaries of the total amount of such appropriations or new obligational authority and outlays for military capital investment programs. In addition, the analysis under this paragraph shall contain—

"(A) an estimate of the current service levels of public civilian capital investment and of military capital investment and alternative high and low levels of such investments over a period of ten years in current dollars and over a period of five years in constant dollars;

"(B) the most recent assessment analysis and summary, in a standard format, of public civilian capital investment needs in each major program area over a period of ten years;

"(C) an identification and analysis of the principal policy issues that affect estimated public civilian capital investment needs for each major program; and

"(D) an identification and analysis of factors that affect estimated public civilian capital investment needs for each major program, including but not limited to the following factors:

"(i) economic assumptions;

"(ii) engineering standards;

"(iii) estimates of spending for operation and maintenance;

"(iv) estimates of expenditures for similar investments by State and local governments; and

"(v) estimates of demand for public services derived from such capital investments and estimates of the service capacity of such investments.

To the extent that any analysis required by this paragraph relates to any program for which Federal financial assistance is distributed under a formula prescribed by law, such analysis shall be organized by State and within each State by major metropolitan area if data are available.

"(2) For purposes of this subsection, any appropriation, new obligational authority, or outlay shall be classified as a public civilian capital investment to the extent that such appropriation, authority, or outlay will be used for the construction, acquisition, or rehabilitation of any physical asset that is capable of being used to produce services or other benefits for a number of years and is not classified as a military capital investment under paragraph (3). Such assets shall include (but not be limited to)—

"(A) roadways or bridges,
"(B) airports or airway facilities,
"(C) mass transportation systems,
"(D) wastewater treatment or related facilities,
"(E) water resources projects,
"(F) hospitals,
"(G) resource recovery facilities,
"(H) public buildings,
"(I) space or communications facilities,
"(J) railroads, and
"(K) federally assisted housing.

Defense and national security

"(3) For purposes of this subsection, any appropriation, new obligational authority, or outlay shall be classified as a military capital investment to the extent that such appropriation, authority, or outlay will be used for the construction, acquisition, or rehabilitation of any physical asset that is capable of being used to produce services or other benefits for purposes of national defense and security for a number of years. Such assets shall include military bases, posts, installations, and facilities.

"(4) Criteria and guidelines for use in the identification of public civilian and military capital investments, for distinguishing between public civilian and military capital investments, and for distinguishing between major and nonmajor capital investment programs shall be issued by the Director of the Office of Management and Budget after consultation with the Comptroller General and the Congressional Budget Office. The analysis submitted under this subsection shall be accompanied by an explanation of such criteria and guidelines.

"(5) For purposes of this subsection—

"(A) the term 'construction' includes the design, planning, and erection of new structures and facilities, the expansion of existing structures and facilities, the reconstruction of a project at an existing site or adjacent to an existing site, and the installation of initial and replacement equipment for such structures and facilities;

"(B) the term 'acquisition' includes the addition of land, sites, equipment, structures, facilities, or rolling stock by purchase, lease-purchase, trade, or donation; and

"(C) the term 'rehabilitation' includes the alteration of or correction of deficiencies in an existing structure or facility so as to extend the useful life or improve the effectiveness of the structure or facility, the modernization or replacement of equipment at an existing structure or facility, and the modernization of, or replacement of parts for, rolling stock.".

Approved October 19, 1984.

LEGISLATIVE HISTORY—S. 1330 (H.R. 1244):

HOUSE REPORTS: No. 98-153 accompanying H.R. 1244, Pt. 1 (Comm. on Public Works and Transportation) and Pt. 2 (Comm. on Government Operations), and No. 98-1134 (Comm. of Conference).
SENATE REPORT No. 98-341 (Comm. on Environment and Public Works).
CONGRESSIONAL RECORD, Vol. 130 (1984):
Feb. 9, considered and passed Senate.
May 15, H.R. 1244 considered and passed House; S. 1330, amended, passed in lieu.
Oct. 4, House agreed to conference report.
Oct. 5, Senate agreed to conference report.

Appendix B

COMMISSIONED BACKGROUND PAPERS

I. Key Public Works Issues

Apogee Research, Inc. "Infrastructure Issues, Problems, and General Solutions." 1-Jul-86, 46pp.
Cuciti, Peggy. "A Perspective on Public Works: The Nature of the Problem." Center for Public-Private Sector Cooperation, Graduate School of Public Affairs, University of Colorado at Denver, 1-Jul-86, 30pp.
Garn, Harvey and Ledebur, Larry C. "Infrastructure in Economic Development." Aslan Institute, 1-Jul-86, 28pp.
Royer, Robert and Carr, Cathleen. "Public Works Improvement: A Concept Paper." Cathleen Carr Associates, 1-Jul-86, 25pp.
Wheeler, Porter K. "Conceptualizing Public Works Needs and Issues." 2-Jul-86, 46pp.

II. Public Works and the Economy

Eberts, Randall W. "An Assessment of the Linkage Between Public Infrastructure and Economic Development." University of Oregon, 1-Jul-86, 40pp.
McGuire, Therese J. "On the Relationship Between Infrastructure Investment and Economic Development." W. Averell Harriman College of Policy Analysis and Public Management, State University of New York at Stony Brook, 1-Jul-86, 26pp.

III. Public Works Needs

Apogee Research, Inc. "The Uses and Misuses of Infrastructure Needs Surveys and Inventories." 1-Jul-86, 33pp.
Coates, Joseph F. and Jarrett, Jennifer. "The Potential Benefits from Science and Engineering for the American Infrastructure, 1985-2015." J.F. Coates, Inc., 1-Jul-86, 115pp.
Cuciti, Peggy and Overman, E. Sam. "The Assessment of Investment Needs: A Review of Current Estimates and Approaches." Center for Public-Private Sector Cooperation, Graduate School of Public Affairs, University of Colorado at Denver, 8-Jul-86, 95pp.
Peterson, George E., Miller, Ted, Humphries, Nancy, and Walker, Christopher. "Infrastructure Needs Studies: A Critique." The Urban Institute, 1-Jul-86, 83pp.
Wells, William G., Jr. "Working Paper on Knowledge Sharing." Department of Management Science, George Washington University, 7-Jul-86, 79pp.

IV. Public Works Financing Trends

Apogee Research, Inc. "Trends in Financing Public Works, 1960-1984." 1-Jul-86, 61pp.
Apogee Research, Inc. "Trends in Public Works Expenditures, 1960-1984." 1-Jul-86, 87pp.
Azad, Bizhan and Jacobs, Michael D. "Infrastructure Finance and Institutions: A Review of International Experience." Department of Urban Studies and Planning, Massachusetts Institute of Technology, 1-Jul-87, 75pp.
Blumenfeld, Arthur A. "Infrastructure and the Finance Profession." 7-Jul-86, 32pp.
Delmer, Clare E. and Menendez, Aurelio. "Infrastructure Finance in the United States: Issues and Mechanisms." Department of Urban Studies and Planning, Massachusetts Institute of Technology, 1-Jul-86, 75pp.
Forbes, Ronald. "Governmental Debt Financing of Public Works." State University of New York at Albany, 1-Jul-86, 100pp.
Fox, William F. "Expenditures for Public Works Infrastructure." University of Tennessee at Knoxville, 1-Jul-86, 54pp.
Fox, William F. "Revenue Sources for Public Works Infrastructure." University of Tennessee at Knoxville, 1-Jul-86, 48pp.
Ledebur, Larry C., Hamilton, William W., Matz, Deborah, and Anderson, Lari. "Federal and State Roles in Infrastructure." Aslan Institute, 1-Jul-86, 93pp.

Petersen, John E.; Mallory, James; Pierce, Lawrence, and Weiss, Barbara. "Non-Debt Financing of Public Works Facilities." Government Finance Research Center, 1-Jul-86, 107pp.

V. Public Works Decisions

APWA Research Foundation. "Public Works Management Practices." American Public Works Association, 1-Jul-86, 75pp.

Coleman, William G. "The Public Works Responsibilities of Federal, State, and Local Governments and the Private Sector." 1-Jul-86, 92pp.

Deloite Haskins & Sells in association with CH2M Hill and Berkeley Planning Associates "A Review of Current Capital Budgeting and Public Works Management Processes." 1-Jul-86, 69pp. plus appendices.

Forbes, Ronald and Cassidy, John. "Public Works Budgeting Practices." State University of New York at Albany, 30-Jun-86, 46pp.

Frank, Carl J. "An Expanded Role for the Dispute Resolution Profession in Public Works on the Threshold of the Twenty First Century." 1-Jul-85, 20pp.

Hanson, Royce. "The Next Generation in the Management of Public Works: Getting Some of it Together." Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, in association with the National Academy of Public Administration, 1-Jul-86, 87pp.

Hatry, Harry P.; Neary, Kevin, and Allen, Joan. The Capital Investment and Maintenance Decision Process in the Public Sector." The Urban Institute, 1-Jul-86, 87pp.

Rood, Sally A. and Rosenberg, Philip. "Capital Budgeting: Small Town Practices in Four States." Philip Rosenberg and Associates, 1-Jul-86, 34pp.

So, Frank S. and Getzels, Judith. "The Planning Profession and Public Works." American Planning Association, 1-Jul-86, 41pp.

Wheeler, Porter K. "The Allocation of Governmental Responsibilities in Constructing, Maintaining, and Financing Public Works." 1-Jul-86, 50pp.

Appendix C

MEETINGS HELD IN PREPARING THIS REPORT

Public forums and meetings with numerous private and public sector groups or individuals were convened to take advantage of a wide range of expertise and practical knowledge on major infrastructure issues. The groups represented were:

Advisory Commission on Intergovernmental Relations

Alliance for Simple, Equitable and Rational Truck Taxation

American Academy of Environmental Engineers

American Association of State Highway and Transportation Officials

American Consulting Engineers Council

American Public Works Association

American Road and Transportation Builders Association

American Society of Civil Engineers

Associated General Contractors of America

Australian National Infrastructure Committee

Building Research Board

Business and public sector leaders from the South to discuss "Business Perspectives on Public Works Issues." Representatives from: developers, accountants, engineers, academics, investment bankers, state planners, chamber of commerce executives, non-profit directors, community development commissioners, corporate chief executive officers, a mayor and a city council member.

Coalition of Northeastern Governors

Congressional Budget Office

Construction Industry Manufacturers Association

Construction Industry Materials and Services Supply Association

Council of State Community Affairs Agencies

Council of State Policy and Planning Agencies

Council of University Transportation Centers

East-West Gateway Regional Council, St. Louis, Missouri

Energy and Environmental Policy Center

Federal Highway Administration

Government Accounting Standards Board

Government Finance Officers Association

Greater Portland Council of Governments, Portland, Maine

Illinois County and Township Roads Association

Interstate Conference on Water Policy

Maine State Planning Agency

National Association of Housing and Redevelopment Officials

National Association of Counties

National Association of Public Authorities

National Association of Regional Councils

National Association of State Budget Officers

National Conference of State Legislatures

National Governors' Association

National League of Cities

National Research Council

National Society of Professional Engineers

National Water Supply Improvement Association

Northeast-Midwest Institute, Leadership Council Infrastructure Task Force

Private Sector Advisory Panel on Infrastructure Financing

Southern Growth Policies Board

Transportation Research Board

Upper Mississippi River Basin Association

U.S. Army Corps of Engineers

U.S. Conference of Mayors

U.S. Department of Agriculture

U.S. Department of Commerce

U.S. Department of Housing and Urban Development

U.S. Department of Transportation

U.S. Environmental Protection Agency

U.S. House of Representatives, Committee on Transportation and Public Works, Subcommittee on Economic Development

U.S. Office of Management and Budget

U.S. Senate Committee on Environment and Public Works, Subcommittee on Transportation

Urban Land Institute

Washington Intergovernmental Roundtable

Appendix D

PUBLIC WORKS EXPENDITURE AND REVENUE DATA: SOURCES, USES, AND LIMITATIONS

There is a wealth of public works expenditure and revenue data collected at the Federal, state, and local levels. However, it must be recognized that these data have limitations and special characteristics that subject them to misinterpretation and/or misuse. Accordingly, policymakers and analysts alike should have an understanding of the sources and limitations of available data. It is the purpose of this Appendix to provide a summary discussion of these issues.[1]

Much of what can be said about public works expenditure numbers—the manner of presentation, types of categories examined and their timeliness— is also true for revenues. This is because both expenditure and revenue numbers are often part of a single collection or survey process.

The following discussions of both expenditure and revenue data each are organized into three parts. The first provides a summary of the major Federally collected data bases. The second reviews the nature of state and local data sources. The third examines examples of other sources of data focusing on special studies and narrowly defined surveys maintained by Federal agencies and professional associations that have specific public works interests.

Expenditures

Major Data Sources

Federal agencies maintain three major public works expenditure data bases. The most frequently used data are those collected by the Bureau of the Census' Governments Division within the Department of Commerce. Another division of the Department of Commerce—the Bureau of Economic Analysis (BEA)—maintains a separate data base covering, among other things, public expenditures for capital structures; these data are consistent with the National Income and Product Accounts series. The third major source of data is provided by the Office of Management and Budget (OMB) as an Appendix to Special Analysis D of the Budget of The United States.[2] This source covers Federal direct obligations for public works as well as grants-in-aid to states and local governments for the same purposes.

Bureau of the Census' Governments Division. Bureau of the Census gathers a variety of statistics on all units of government in the nation as part of the Census of Governments, taken at 5-year intervals in years ending in "2" and "7". Financial statistics of state and local governments have been assembled in periodic censuses for more than a century and in annual surveys since 1898. The surveys cover 21,000 governments, providing nationwide and state-by-state numbers for revenues, expenditures, debt, and financial assets. The data are used for a variety of purposes including public information and education, development and appraisal of government policies, economic and governmental research, guidance on economic activities of the private sector, and the execution of a variety of programs at all levels of government.

The goal of the Bureau of the Census is to collect data that describe the fiscal condition of government units from a budgetary perspective. Hence, their reporting categories look very much like typical public budgets. Moreover, in choosing a fiscal year convention for reporting data, the Census draws an even closer parallel to budgeting practices.

In addition to the comprehensive census every 5 years, financial data are published annually in the Census' Government Finances series of reports which include:

- *Government Finances*, which covers all governments at a summary level;
- *State Government Finances*, which provides more detailed data for the 50 states;
- *City Government Finances*, which provides data for cities and urban townships with populations of 50,000 or more; and
- *County Government Finances*, which provides data for counties with populations of 100,000 or more.

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[1] A more detailed discussion is available in Apogee Research, Inc., "Trends in Public Works Expenditures, 1960-1984," and "Trends on Financing Public Works, 1960-1984," in reports Prepared for the Council, July 1986; and William F. Fox, "Expenditures for Public Works Infrastructure," and "Revenue Sources for Public Works Infrastructure," reports prepared for the Council, July 1986.

[2] Office of Management and Budget, *Special Analyses of the Budget of the United States Government*, Washington, DC: U.S. Government Printing Office, Annually)

Of these reports, the *Government Finance* series is the most detailed compilation of Federal, state, and local public works expenditure data. Expenditures are presented as government outlays from two perspectives: by "character and object" or by "sector and function."

The "character and object" classification divides outlays by each level of government into the following categories: intergovernmental expenditures and direct expenditures for own purposes. Direct expenditures are further broken down into current operation, capital outlay, assistance and subsidies, interest on debt, and insurance benefits. Capital outlays are broken down still further into construction, equipment, and land and existing structures.[3]

The "sector and function" classification, also arrayed by level of government, displays several sub-sections relevant to public works. These sub-sections include transportation (highways, air transportation, and water transport), environment and housing (natural resources, sewerage, sanitation other than sewerage, and housing and urban renewal), and public utilities (including water supply and transit systems).

The data on Federal expenditures come primarily from the data published by OMB in the *Budget of the United States Government*. Annual reports of the Secretary of the Treasury and the Commissioner of Internal Revenue provide supplementary detail. Federal payments to state and local governments are obtained from the contributing Federal agencies in some cases. All Federal data are collected on an agency-by-agency basis and then grouped into functional categories on the basis of each agency's functional orientation.

State government expenditures are compiled by the Bureau of the Census from official records and reports of the 50 states. Local expenditure data are estimated from a random sample of local governments. This sample includes all county governments and municipalities with populations greater than a set amount (which varies with the decennial Census of Population); all local governments whose relative importance within the state in terms of expenditure and debt is above a set standard; and a random selection of local governments from the rest of each state.

With few exceptions, Census data are sufficiently rich in detail and coverage so that both operating and capital expenditures are either provided directly as line items in the various reports or in a form that allows them to be calculated using several line item entries. Modes covered include highways, airports (air transportation), wastewater facilities (sewerage), water supply systems (water utilities), and mass transit (transit utilities).

Census data are considered the most reliable, albeit the least timely, of all centrally collected national data sets. Federal expenditure data—the actual figures compiled from the U.S. Budget--must be considered certain for all practical purposes. State and local expenditure data, on the other hand, are reliable only to the extent that reports of these jurisdictions are reliable. Census makes reasonable efforts to control this variability by using standard categories for reporting and by subjecting the data to extensive internal review.

Bureau of Economic Analysis. The Bureau of Economic Analysis (BEA) does not collect primary data on public works expenditures. Rather, the agency collects current data from OMB (Federal spending) and from Census updates on state and local construction. Some state and local data are gathered from the Department of Transportation. Once these data are collected, BEA adapts them to its accounting format. BEA data are published in order to provide consistent estimates of national economic aggregates—GNP and its major divisions. Each July, BEA publishes a separate government capital spending series in the *Survey of Current Business*. This series contains current and constant dollar estimates of construction, equipment, and net purchases of existing structures by level of government (Federal, state, and local).

Unlike the Bureau of the Census, which publishes annual outlay expenditure data by fiscal years, the BEA views spending by calendar years for "gross product" or construction projects completed. BEA's approach to government expenditures contribute to GNP rather than to the fiscal condition of governments. Only net additions or subtractions are recorded; transfers of assets such as loan programs are excluded, and, since changes in land value do not represent added current output, land purchases are also excluded.

Because BEA's charge is to assemble available data in terms of national aggregates, most of its published work is less detailed than the Census data. Except for combined government construction, BEA's published data contain relatively little regional or functional detail. However, the Bureau may provide, upon request, more detailed unpublished capital expenditure data for 21 functional categories separated by level of government.

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[3] The Census definition of capital outlays is for purchases of equipment, land and existing structures. This includes amounts for additions, replacements, and major alterations to fixed works and structures; however, expenditures for repairs to such works and structures are classified as current operating expenditures.

There is no practical way to measure uncertainty in the BEA data because there is no benchmark against which to compare the BEA estimates. Most local or state accounting of construction is for outlays, not construction put-in-place as is the BEA convention. The agency achieves a high degree of internal consistency by routinely re-estimating earlier figures. The data published for the current quarter are almost always adjusted during the quarter that follows. After several quarters, BEA has obtained nearly all the changes in its input data, which suggest that data about a year old will change very little after that.

Office of Management and Budget. Since 1985, the Federal Office of Management and Budget (OMB) has published annually "Supplement to Special Analysis D of the United States Budget," as required by the Federal Capital Investment Program Information Act of 1984 (Title II of P.L. 98-501).[4] This document includes projections of Federal investment spending and a review of recent assessments of public civilian investment needs.

OMB data are collected for fiscal years from the budget estimates submitted by the various Federal agencies. Data are presented only for direct Federal spending on construction and rehabilitation of physical structures and grants-in-aid to state and local governments for the same purposes. State and local direct general expenditures are not covered. Federal spending for current operations are similarly excluded.

The major limitation of the OMB series from a public works viewpoint is that it is limited to Federal outlays. While these data are very useful in analyzing Federal spending trends and their policy implications, similar analysis of non-Federal trends are impossible. Other limitations include the absence of regional disaggregation of national figures that makes regional analysis impossible; the lack of a distinction between direct Federal outlays and grants-in-aid for the same purposes; and failure to include two other forms of Federal assistance to local construction of major physical capital: credit programs and tax expenditures. Although these data are available, they are not necessarily in a form comparable to data on direct spending and grants-in-aid. Budgetary information regarding credit programs—loans and loan guarantees—may be found in Special Analysis F, "Federal Credit Programs", and Special Analysis H, "Federal Aid to State and Local Governments."

State and Local Reports

State and local government annual reports are an additional source of data on capital expenditures. Generally, they provide information on the capital expenditures by state governments by function. A major problem with such data is the lack of a consistent definition of terms and accounting practices, even for capital versus operating expenditures.

A survey of cities illustrates the potential problem that can arise when some cities consider a particular expenditure to be a capital item and others consider the same item as a current expenditure.[5] Nearly one-half of the cities reported preventive maintenance in the capital budget, which means just over one-half did not. Nearly one-fourth of the cities did not include major maintenance in their capital budgets and five percent did not include capital expansions in these budgets. All data series which rely on state or local governments to provide the raw data need to use careful controls to guarantee consistent capital definitions.

State and local annual report data would be costly to compile into a historical series because the reports would need to be collected from each state for each year. Further, they would not list investments by local governments within their state. The audits that report capital expenditures for local governments in many states could be added to a state's annual report, but the data are subject to the same definitional problems and often fail to provide the annual detail by function that would be needed to build a time series.

Other Data Sources

There are several other sources of public works expenditure data that are currently available. Five of the most important are summarized below. The first two provide one-time but broad coverage of the nation's public works. The other three are more narrowly targeted but continuing.

Congressional Budget Office (CBO). The CBO has assembled time series data on public works expenditures for the period 1950-1984. These data are all secondary, having been provided by Census, OMB or other Federal agencies responsible for public works programs. The principal strength of the CBO data is the level of disaggregation by function, object and level of government. In addition, CBO has provided detailed analyses of trends in the data. Moreover, for some public works modes, sources of financing are linked to expenditures. However, the CBO provides no regional analysis, and the evaluations presented all focus exclusively on Federal concerns.

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[4] Office of Management and Budget, *Special Analysis*, op. cit.

[5] The survey, conducted by the U.S. Conference of Mayors in 1983, is reported in Fox, "Expenditures for Public Works Infrastructure," op. cit., pp. 8-9.

CONSAD Research Corporation. In 1980, the CONSAD Research Corporation completed a study for the U.S. Department of Commerce that addressed a wide range of infrastructure concerns. In addition to using Census and BEA numbers, two original data collection efforts were made. The first was a mail and phone survey of thirteen Federal agencies having public works responsibilities. The second effort, a mail survey of members of the Municipal Finance Officers Association, was an attempt to link expenditures to sources of revenues at the local level. The generally low level of survey responses hinders use of the CONSAD data. In addition, the CONSAD data are current only through 1977 and no further work has been undertaken to update them.

EPA Wastewater Treatment Expenditures. In connection with its periodic needs surveys, the Environmental Protection Agency (EPA) compiles economic and technical data for each of the existing and planned wastewater treatment plants in the nation. The agency has conducted such a survey every two years since 1973, making the data available to the public about a year after collection. Limited information on expenditures is generally not published as part of the main report, which focuses instead on projected financial needs. However, the agency does maintain capital costs incurred on a plant-by-plant basis in a special computerized data base.

Because the data are designed to forecast investment needs for wastewater facilities over a 20-year period, the data on expenditures already incurred are limited. Moreover, the data cover only those treatment facilities which are eligible for Federal assistance. Therefore, major state and local expenditures for related, but ineligible, wastewater treatment facilities are excluded.

UMTA Public Transit Data. Under Section 15 of the Urban Mass Transportation Act of 1964 (a section added in 1978), the Urban Mass Transportation Administration (UMTA) is required to collect annually financial and operating data from the nation's Federally supported transit operators. Expenditure data are collected through surveys sent to each operator with results checked for internal consistency by UMTA. Expenditure data are presented by individual operator as well as aggregated nationally to seven system size categories by mode (bus, rapid rail, streetcar, trolley, ferryboat, other); by function (vehicle operation, vehicle maintenance, non-vehicle maintenance, general administration); and by object class (wages, materials, insurance, miscellaneous).

These UMTA data are made available about one year after collection in printed tables as well as computer readable form, and are used by transit operators to compare relative cost-effectiveness. This use is encouraged by the calculation of a range of performance indicators such as operating costs per passenger mile and vehicle miles per breakdown. Sec. 15 data have been improved recently because they are being used in determining the allocation of Federal funds.

Non-financial data collected include inventories of equipment and facilities by age, employee counts, and accidents.

FHWA Expenditures. The Federal Highway Administration collects detailed data from states on expenditures by level of government with considerable detail by capital and operating categories and by road type (collector versus arterial and Interstate System versus Secondary, for example). These are generally available annually about 9 to 12 months after the close of the fiscal year as well as historically from 1921 in somewhat less detail. These data are incorporated into the BEA series described above.

Revenues

The collection and reporting of revenue data parallels the process for expenditures data. For centrally collected and reported data, the same three Federal agencies play the key role. State and local reports, and a variety of less comprehensive sources also contribute significant revenue information.

Congressional Budget Office, *Public Works Infrastructure: Policy Considerations for the 1980's* (April 1983); and Congressional Budget Office, [illegible]

CONSAD Research Corporation, *A Study of Public Works Investment in the United States*, A report prepared for The Economic Development Administration, U.S. Department of Commerce, 1980, 4 Appendices.

Urban Mass Transportation Administration, [illegible] (Washington, DC: U.S. Government Printing Office, [illegible]

Comprehensive Federal Sourcess

The most frequently used data come from the Governments Division of the Census Bureau. The Bureau of Economic Analysis and the Office of Management and Budget also report revenue data, but in a manner consistent with their specific needs. The BEA maintains a data base that is consistent with the requirement of the National Income and Produce Accounts; and OMB reports primarily Federal data, along with some state data needed to assist in Federal policy development.

The major limitation of these sources, however, is that they do not link receipts to expenditures for public works. Hence they can be used only to characterize trends in total government revenues.

Time-series on state and local debt are provided by government and non-government sources as discussed below. Census, BEA, and OMB provide data on Federal grants-in-aid to non-Federal governments. State and local own-source funds appear in the Census and BEA tabulations as government receipts, but there is no way to separate own-source funds used to finance public works programs from those used in other ways. Perhaps the most convenient way to do this (if compelled to use only centrally collected data) is by elimination—subtracting the sum of intergovernmental aid plus debt from total public works expenditures.

Without question, the best data on financing public works by mode are collected either by the Federal agencies that administer aid programs or by industry associations representing the mode in question. Unfortunately, these disparate sources of data, though generally detailed within a mode, have never been reconciled into a coordinated data series. These individual sources are discussed briefly below.

Bureau of Census' Governments Division. The Census' collection and reporting of revenue data is carried out in conjunction with the expenditure collection and reporting process described earlier. Accordingly, the process described above for expenditures is the same in terms of the timing of the surveys, the five major reports, and the primary sources for Federal data (Budget of the U.S. Government) and state and local data (official state records and surveys of several thousand jurisdictions). These data have the same lack of timeliness and other limitations as the surveys from which they are drawn.

As was the case for expenditures, the Government Finance series provides the most detailed information for the three levels of government (Federal, state, and local). Here, the major differences between the expenditure and revenue series derive from the categories of data reported and the modes financed. Specifically, Census provides three categories of receipts:

- General Revenue including taxes (individual income, corporate net income, sales, property, and other) and other charges (postal receipts, interest earnings, user fees);
- Utility and Liquor Store Revenue only at the state and local levels;
- Insurance Trust Revenue including employee retirement, unemployment compensation, disability, health, and other.

Because of the lack of clear linkage between public works expenditures and taxes raised, there is no way to relate the respective contributions of tax and user fee receipts as reported to the Census to the financing of individual public works modes. This makes it impossible to use these data to evaluate the effects of shifting revenue sources on public works investments. Utility categories, however, are broken down into the following four categories: water supply, electric power, transit and gas supply.

Bureau of Economic Analysis. BEA data are collected in support of the National Income and Product Accounts, receipts include only those that contribute to current income. This excludes transactions such as loans or loan guarantees, which are exchanges of assets. BEA data also exclude any transactions with the five U.S. territories, including grants-in-aid to them and receipts collected from them. This is a major departure from the Census or OMB conventions. BEA revenue data, nonetheless, have the same major limitation as Census data with respect to analysis of public works financing; they do not relate revenues by source to public works expenditures.

For Federal revenues, the BEA data, which are presented by calendar rather than fiscal year, are comparable in detail to the Census data. The state and local component of the BEA data, however, is not comparable in detail to the Census data. Federal receipts include the followig categories:

- Personal tax and non-tax *receipts* including income taxes, estate and gift taxes, and non-tax receipts (user fees from government owned enterprises);
- Corporate profit tax *accruals*;
- Indirect business taxes including excise taxes and customs duties; and
- Contributions for social insurance.

State ~~and local government rece~~ipts are similar:

- Personal tax and non-tax *receipts* including income taxes, estate and gift taxes, motor vehicle licenses, property taxes, and other taxes; tuition; hospital and health charges, and fines;
- Corporate profit tax *accruals*
- Indirect business taxes including sales taxes (seven state and three local sales tax categories), property taxes, severance taxes, and others;
- Contributions for social insurance; and
- Federal grants-in-aid

Office of Management and Budget. Since 1985 (in conjunction with the fiscal 1986 budget), the OMB has published a separate budget volume, *Historical Tables, Budget of the United States Government (Selected Fiscal Years)*, which provides time series data on Federal spending as well as receipts. OMB data are collected for fiscal years from the budget estimates submitted by the various Federal agencies. The data on Federal government receipts and grants-in-aid to state and local governments are pertinent to this study. However, like the two previous sources, receipts are not linked to their use in financing public works programs. Thus, there is no practical way to link Federal receipts to Federal financing of programs except in the case of Federal highways, airports and inland waterways which are funded from trust funds.

For purposes of a study of public works, the OMB data has another limitation which it shares with BEA data—i.e. there is an absence of regional disaggregation of receipts below the national level.

OMB also publishes several special analyses which have relevance to infrastructure finance questions. For example, Special Analysis E summarizes current developments in Federal borrowing. Topics covered include: size and growth of Federal debt (with time-series data presented), borrowing by Federal agencies, Federal funds financing, and Federally assisted borrowing. While many of these data do not directly pertain to the financing of public works, the volume and characteristics of Federal borrowing affects the tax-exempt bond market—a major supplier of capital for state and local public works investments.

Special Analysis F describes the activities of Federal credit programs, including Federal direct loans and Federally guaranteed loans, that are privately issued. Together, these activities make the Federal government the largest financial intermediary in the nation. Special Analysis F provides detailed data on a program-by-program basis covering direct loans, loan guarantees, and the activities of government-sponsored enterprises. These pertinent to the financing of public works include the Farmer's Home Administration direct loan program for rural water and sewer projects, the Bureau of Reclamation loans for small water development projects, and the highway right-of-way revolving fund.

Special Analysis G, entitled Tax Expenditures, estimates Federal tax revenues foregone because of special exclusions, exemptions, or deductions.[9] This analysis presents two calculations of tax expenditures: revenue losses and outlay equivalents. The revenue loss estimates most pertinent to public works are those attributable to the tax exclusion of interest on state and local debt and the deductability of state and local taxes. These estimates are presented for the current fiscal year and for one year before and after the current year.

Special Analysis H covers all three basic types of Federal aid to state and local governments—grants, loans, and tax expenditures, but the discussion and data on tax expenditures are not as detailed as in Special Analysis G. Grants are the most important form of aid for financing public works. Data on Federal grant outlays are displayed by general budget function and by individual aid programs for the three years encompassing the current fiscal year. Grant programs pertinent to public works financing include watershed and flood prevention; wastewater treatment system construction; Federal highway aid; mass transit; grants-in-aid for airports; rural water and waste disposal, economic development assistance; community development block grants; and Appalachian regional development.

State and Local Reports

As was true for expenditures, state government reports can be quite useful in analyses of revenues generated in support of public works infrastructure if used on a state-by-state basis. However, separate state reports provide an inadequate basis for making interstate comparisons of financing policy. Not only do individual states adopt differing definitions of tax and other revenue sources, but the categories of taxes are not comparable. In some states, for example, a utility fee may be collected through governments and placed in a special infrastructure related fund. In other states, however, these same fees may be reported not as a public receipt but as a payment to a private utility district.

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[9] While there is disagreement as to whether this concept is appropriate, calculating these estimates is required by the Congressional Budget Act of 1974 (P.L. 93-344).

As a result, a combination of data aggregation and use of uniform definitions is needed in order to draw state-by-state comparisons. The volume that best puts this all together is the annual *Significant Features of Fiscal Federalism* report that is published by the U.S. Advisory Commission On Intergovernmental Relations (ACIR).[10] Using data from a variety of sources (especially Census) the ACIR provides several data sets that permit one to compare revenues (as well as some expenditures) among the states.

Other Data Sources

Several other sources of data focus on a limited number of infrastructure modes, levels of government, or periods of time. Nonetheless, because they relate directly to the financing of public works, they can be extremely useful. The following list of sources is representative of such information.

UMTA Section 15 Data. Beginning with fiscal year 1979-1980, the Urban Mass Transportation Administration has published financial data from its survey of transit operators. These data, which are organized by size of systems, are presented in five divisions: sources of transit revenue (fares, taxes, grants and cross subsidies); sources of operating assistance (Federal, state and local aid, general revenues, dedicated taxes, and tolls); state and local taxes dedicated to transit operations (income, sales, property, commuter, other); sources of public capital assistance (general revenues and dedicated sources); and state and local taxes dedicated to capital assistance (income, sales, property, commuter, other).

Federal Highway Administration. Federal highway finance statistics have been published annually since 1945.[11] Historical data were published separately in 1975, covering the period 1900-1975 as data allowed. Highway finance data are presented in four sections: summary, Federal, state, and local. The categories of receipts include motor fuel and vehicle taxes, tolls, property taxes, general fund appropriations, bond proceeds, intergovernmental payments, and interest on investment. Receipts to the national Highway Trust Fund are displayed separately. The agency warns users to be particularly careful to avoid double counting in the finance data. For example, Federal-aid payments to states are reported both as state receipts and as state expenditures.

The Public Securities Association (PSA). The PSA series of long-term bond sales tabulates the number and volume of bonds issued, classified by some 30 parameters, including the type of issuer and use of proceeds. New capital is distinguished from refunding. Information on use of proceeds includes categories for education, transportation, utilities and conservation; social welfare; industrial aid; public services, recreation, and unclassified. The PSA data cover the following types of issuers: states, counties (including boroughs), municipalities (cities, towns and townships), utility districts, and special authorities. Data are published quarterly and are available from 1966 to the present. However, the data series only covers publicly sold issues. Thus, its coverage has become less comprehensive as the private sale of bonds has increased recently. PSA data currently cover about 85 percent of total bond sales.

The Government Finance Officers Association (GFOA). In cooperation with the Joint Economic Committee of the U.S. Congress, the GFOA has conducted annual surveys since 1978 of the fiscal condition of cities. The most recent survey, published in 1985, collected data from 250 municipalities ranging in population from 10,000 to over 250,000. This survey covered government operating revenues and expenditures, capital outlays and financing, enterprise fund finances, long-term borrowing and debt outstanding, changes in the work force, and city economic development programs. Because the survey is limited to the 250 city sample, and the respondents may vary from year to year, the data cannot be used for either extrapolations to the nation as a whole or for time series analyses. The data are, however, quite useful for other purposes. For example, they are an important source of systematic data on local enterprise funds. An enterprise fund is administered separately from other city finances, and generally covers the operations of government units such as water utilities, sewer authorities, airports, and local transit authorities.

Congressional Budget Office (CBO). The CBO has recently published a series of reports addressing the financing of public works in general, and the financing of individual public works modes.[12] The CBO's general studies cover highways, airports, transit, water supply, wastewater treatment, water resources, and rail. Individual studies have been published on highways, airports, wastewater treatment, and water resources. A study on the water supply industry will be published this year. Most of CBO's work focuses on Federal financing, although the modal studies cover financing by all levels of government. The level of detail and period over which data are presented varies by study. The sources of data that appear in CBO documents generally are those noted above, although occasionally the CBO collects its own data from user groups or individual facilities.

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[10] The most recent volume: U.S. Advisory Commission on Intergovernmental Relations, *Significant Features of Fiscal Federalism*, 1985-86 edition, Report M-146 (Washington, DC: U.S. Government Printing Office, 1986), 263 pages (indexed).

[11] See, for example, Federal Highway Administration, *Highway Statistics 1984*, U.S. Department of Transportation (1984).

[12] Congressional Budget Office, *The Federal Budget for Public Works Infrastructure* (July 1985); *Public Works Infrastructure: Policy Considerations for the 1980s* (April 1983); *Financing U.S. Airports in the 1980s* (April 1984); *Efficient Investments in Wastewater Treatment Plants* (July 1985); *Financing Water Supply Systems in the 1990s* (forthcoming 1986).

American Public Works Association (APWA). Every ten years the APWA surveys its members regarding the financing of public works and other related topics. The most recent survey was conducted in 1980. Members were asked to provide their annual operating budgets for 1970 through 1980 as well as the average amount spent on public works capital improvements between 1975 and 1979. In addition, respondents noted which sources of financing were used, but not the value of receipts from each. The limitations of the sample notwithstanding, the APWA data provide a means of linking sources of funds to uses.

THE NATION'S PUBLIC WORKS:

EXECUTIVE SUMMARIES OF NINE STUDIES

CATEGORIES OF PUBLIC WORKS SERIES

INVITATION TO COMMENT

The material in this report was prepared for the Council by independent contractors. The Council invites comment from all interested parties for the purpose of assisting the Council in the preparation of its final report to the President and the Congress.

National Council on
Public Works Improvement
May 1987

COMMISSIONED STUDIES ON NINE CATEGORIES OF PUBLIC WORKS

The Congress created the National Council on Public Works Improvement in P.L. 98-501 to report to the President and the Congress on the state of the nation's infrastructure. In an effort to meet its legislative commitment, the Council commissioned the following categorical studies:

Airports and Airways
by Richard Mudge
Apogee Research, Inc.

Highways, Streets, Roads and Bridges
by Alan E. Pisarski

Mass Transit
by Ronald F. Kirby and Arlee T. Reno
The Urban Institute

Intermodal Transportation
by Joseph S. Revis and Curtis Tarnoff

Wastewater Management
by Lawrence Olinger
Apogee Research, Inc.

Water Resources
by Kyle Schilling, Claudia Copeland, Joseph Dixon,
James Smythe, Mary Vincent, and Jan Peterson

Water Supply
by Wade Miller and John Cromwell
Wade Miller Associates, Inc.

Hazardous Waste Management
by Kenneth Rubin
Apogee Research, Inc.

Solid Waste
by Jeffrey F. Clunie
R.W. Beck and Associates

Copies of these reports are available from the National Council on Public Works Improvement, 1111 18th Street, Northwest, Suite 716, Washington, DC 20036, (202) 653-0298.

EXECUTIVE SUMMARIES

OF

NINE STUDIES

National Council on Public Works Improvement
1111 18th Street, N.W., Suite 716
Washington, D.C. 20036

NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

May 1987

Council
Chairman
Joseph M. Giglio

Peter C. Goldmark, Jr.

Freeman Holmer

Lowell Jackson

Frieda K. Wallison

Executive Director
Nancy S. Rutledge

Dear Mr. President and The Members of Congress:

The National Council on Public Works Improvement is pleased to submit its second report, in the form of papers prepared for the Council on nine categories of public works. These include roads, streets, bridges and highways; mass transit; airports; intermodal transportation; water resources; water supply; wastewater treatment; solid waste; and hazardous waste.

The National Council on Public Works Improvement was established by the Public Works Improvement Act of 1984. On September 18, 1986, the Council submitted its first report, The Nation's Public Works: Defining the Issues.

The categorical studies submitted to you today were prepared under the auspices of the Council to assist the Council in examining major issues affecting public works improvement in the United States. As such, they do not necessarily represent the views of the Council as a whole or individual members of the Council, but rather reflect the respective opinions of the authors of the studies. They will be used by the Council, along with other commissioned research, in the preparation of the Council's final report.

Sincerely,

Joseph M. Giglio

Joseph M. Giglio
Chairman

1111 18th Street, N.W. Suite 716, Washington D.C. 20036 (202) 653-0298

PREFACE AND ACKNOWLEDGEMENTS

In preparing a final report to the President and the Congress on the state of the nation's infrastructure, the National Council on Public Works Improvement (the "Council") examined in detail several major categories of public works. The selected categories are:

1. Roads, streets, highways and bridges
2. Airports and Airways
3. Mass Transit
4. Intermodal aspects of transportation
5. Water projects (ports, waterways, dams, facilities for irrigation and flood control, etc.)
6. Water supply
7. Wastewater treatment
8. Hazardous waste management

This document presents summaries of those nine studies. Each summary highlights themes and recommendations that emerged in the full-length reports. Those reports are available from the Council upon request.

Each consultant study responded to a standard research outline developed by the Council to ensure the thorough and systematic review of each category by an assigned contractor. The contractor was assisted by a "working group" of experts. One or more members of the Council attended each working group meeting and participated in discussions of the initial outlines and drafts prepared by the contractor.

The Council wishes to thank all of the contractors and individuals who participated in the working groups. The working group members are listed following each summary.

The summaries herein, and the full-length reports they represent, reflect the views of the contractor and may not reflect the views of the Council or members of the working group. This document has been printed and is being distributed at this time to stimulate discussion among a wide variety of interested parties.

Comments will be most useful if received by the Council before September 1, 1987, in order for such comments to be considered by the Council in preparing its final report to the President and the Congress.

EXECUTIVE SUMMARIES OF CATEGORICAL STUDIES

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TRANSPORTATION

HIGHWAYS, STREETS AND BRIDGES

Alan E. Pisarski

The American road system is owned and operated by states and local governments based on their strong and independent interests in having a viable road network to serve their own needs. Federal assistance promotes and assists, but does not control the level of effort or direction of interest of other governments in the road system. Over 38,000 units of government own roads or have road responsibilities.

The 3.8 million miles of highways in the country are classified by function into a series of interconnected networks. The arterioles at the high end of the hierarchy, such as the Interstate System, carry the predominant share of traffic volumes and interstate commerce and are the main focus of federal assistance and state matching funds.

The centerpiece of the highway development and revenue system is a user charge relationship between users and providers of highways that seeks to assure that users pay an equitable share of the costs they impose on the road system and that their payments, in turn, are efficiently expended on programs dedicated to the needs of the user. This revenue generation system, primarily structured around fuel taxes, presently generates in excess of $ 60 billion per year, some of which is diverted from highway uses to other purposes. State revenues are the majority of these revenues, with federal and local revenues each amounting to a quarter of the revenue pie. Federal funds are almost entirely from user fees, while property taxes, general revenues, and distributions of state and federal user fees are the primary sources of local receipts.

The federal-aid program provides assistance to eligible amounts of mileage in each state, according to the functional classification of roads in the state, ranging from 75% of costs on most roads to 90% on the Interstate system. Current levels of federal aid are about $13 billion accounting for less than 25% of total highway expenditures. State programs emphasize support for the higher ends of the system hierarchy, while local jurisdictions have responsibility for the vast majority of local streets and roads which serve to access land and connect to the higher levels of the road system.

The growth in federal revenues, resulting from the five cent increase in the federal fuel tax and other imposts, under provisions of the 1982 Surface Transportation Assistance Act; and the parallel state increases in local fuel taxes and other fees, have provided a substantial infusion of funds into road system programs. These new revenues have resulted in rapid progress in the condition of pavement surfaces. Based on a rating scale from poor to good, the number of road miles in poor condition have decreased by about 10% - 30%, depending on the road type, with greatest improvement at the high end of the functional hierarchy.

With these rapid improvements, road operating costs have also begun to improve as a function of pavement quality. However, increasingly sophisticated needs analysis indicate a substantial amount of underinvestment is still occurring. Beyond changes in road surface, the system requires treatment of underlying structural deficiencies and expansions of capacity. These analyses would place the dollar scale of these investments on the order of an additional $20 Billion per year.

Americans have almost a trillion dollars invested in vehicles of all kinds and a substantial amount of their workplace time and personal time invested in road travel as well. Public investment in the road system is the enabling expenditure that controls the efficient use of these vast private assets. Were the public sector to recognize its marketplace role in the supply of road infrastructure, providing the roads that users want and are willing to pay for, substantial improvement in user operating costs would occur, making valuable contributions to enhanced national productivity and international competitiveness.

To recognize the immense potential benefits of adequate levels of road investment will require a shift away from the antagonistic policies toward roads and road use of the past, toward a public policy that is capable of sensing effective demand for roads and responding to it cost-effectively.

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MASS TRANSIT

Ronald F. Kirby and Arlee T. Reno

Mass transit plays an important role in the transportation systems of virtually all U.S. cities, though its role varies considerably with city size. In very large cities like New York, Chicago, and San Francisco-Oakland, rail and bus transit systems provide much of the capacity for downtown-oriented travel, accounting for over half of all daily work trips to and from the central core. In medium and smaller urban areas transit serves much lower proportions of trips, but still provides an important source of mobility for urban residents, particularly those without convenient access to a private automobile. Many of the smallest urban areas with insufficient demand to justify bus or rail mass transit systems rely instead on various forms of paratransit services, including car pools, shared taxis, and minibuses. Such paratransit services also play an important role in larger urban areas, to supplement conventional mass transit in high density areas, and to provide substitute services for low density travel and for special user groups unable to use conventional transit.

In urbanized areas (population over 50,000), mass transit in 1984 was a $14 billion industry. Only $4 billion came from fares and other transportation revenue: about $10 billion was provided in direct capital or operating assistance by federal, state, and local governments. A further $1.9 billion was expended on various forms of transit in nonurbanized areas (population under 50,000). Only $0.4 billion of these expenditures in nonurbanized areas came from fares and other transportation revenues: the remaining $1.5 billion came from federal, state, and local governments. With $11.5 billion in annual expenditures on mass transit, the various levels of government have a great deal of interest in the efficient management and operation of these services. There is considerable evidence in the literature to suggest, however, that current forms of governmental regulation of, and assistance to, mass transit have led to inefficiencies and unnecessarily high subsidy costs. Growing recognition of these problems has stimulated a number of evolutionary changes in public policies and programs, and has indicated directions for further changes.

In the early part of this century, governmental involvement in mass transit was limited to regulatory activities: local governments awarded exclusive operating franchises to streetcar and bus companies in return for their commitments to maintain prescribed fare and service levels. Many have argued that this institutionalization of transit monopolies was a mistake, in that it precluded the competition needed to control costs and stimulate new and more attractive service offerings. As increasing automobile ownership and low density suburban development eroded the market for mass transit after World War II, these transit monopolies gradually sank into bankruptcy, in large part because local authorities would neither approve fare increases and service cutbacks requested by transit managers, nor directly subsidize unprofitable services that they insisted should continue to be provided. These policies created a financial crisis in urban mass transit, which led to private transit firms deferring capital maintenance and replacement, and seeking to relinquish their financial participation in urban transit systems.

The financial involvement of governments in mass transit grew primarily out of concerns that the deteriorating condition of the capital equipment of the private transit companies might lead to the abandonment of much of the existing transit service structure. The rationale for governmental involvement, particularly at the federal level, was that it was needed to provide the large amounts of money required to recapitalize the transit industry. The federal Urban Mass Transportation Act of 1964 created a discretionary capital assistance program which placed the federal government in the role of an investment banker for mass transit, encouraging local transit buyouts and new investments and providing up to two thirds of the funds to finance them. With the aid of these federal funds, city after city purchased the assets of its private transit company and established a public transit authority. In 1974, the federal government began to provide operating subsidies as well as capital assistance for mass transit, and state and local governments gradually increased their financial contributions to match federal funds and to provide additional capital and operating funds. In the larger cities, public ownership and subsidies predated federal involvement, with state and local governments providing the initial funding required. These decisions to move mass transit systems into the public sector were resisted by some as further institutionalization of transit monopolies, and in recent years there have been efforts to reintroduce private sector participation in mass transit through various privatization strategies.

As the level of governmental financial involvement in transit grew, so too did the number and scope of various governmental mandates on the recipients of public funds. In addition to earlier requirements on service levels and fares, transit managers found themselves having to conform to a range of planning, programming, and reporting procedures, to specifications on vehicles and other capital acquisitions, to reduced off-peak fare provisions for the elderly, to provision of specialized services for disabled persons unable to use conventional services, and to labor protection requirements precluding any worsening in the conditions of existing transit workers. All of these mandates had implications for the costs of transit services, although typically these costs were neither quantified fully nor related directly to the levels of governmental assistance being provided. The federal government embarked on an ambitious program of research aimed largely at developing improved vehicle and other technologies for transit, predicated on the view that transit improvements would come primarily from federally-assisted investment in advanced bus, rail, and other fixed-guideway transit systems. With each renewal of transit funding, new aspirational goals were assigned to transit, including reviving decaying downtown areas, reducing air pollution, conserving energy, serving the travel needs of the disabled, and reducing traffic congestion.

After some twenty years of experience with mass transit owned, operated, and heavily financed by the public sector, a number of careful assessments by the U.S. General Accounting Office, the Congressional Budget Office, an Oversight Subcommittee of the U.S. House of Representatives, the U.S. Department of Transportation, and various private agencies have concluded that mass transit policies and programs in the United States have fallen well short of their objectives, and are in need of revision. In part, the shortfall in the accomplishments of mass transit has been due to an unwillingness on the part of governments to enact various supporting measures to promote transit use, such as higher gasoline taxes, elimination of parking subsidies, regulation of the use of congested roads, and zoning to encourage higher density development around transit lines and stations. In countries like Canada which have enacted such measures, mass transit systems have performed much better. However, there is little indication at present of any shift toward more transit supportive policies in U.S. cities. To the contrary, local zoning and road development policies continue to reinforce low density suburban and exurban development which is difficult for mass transit to serve efficiently.

The disappointing performance of mass transit in U.S. cities can be attributed primarily, however, to inappropriate governmental policies and programs. The federal government has not performed particularly well in the roles of investment banker for local transit investments developer of new technology, and partial supporter of transit operating costs. Political pressures within both the Congress and the Executive branch have led to some notably poor transit investments and to several rather ill-conceived and costly research undertakings. The large discretionary capital element of the federal transit program has distorted local decisionmaking toward capital-intensive transit systems which qualify for federal capital assistance, and led to the neglect of more cost-effective strategies such as provision of preferential lanes for other high-occupancy vehicles. (After 1973 the Federal- Aid Highway laws permitted the use of federal highway funds for high-occupancy lanes, but required a 30 per cent local share as compared to the 20 per cent local share then required for transit capital projects.) Major efforts to regulate planning and programming procedures at the local level have had relatively little effect on local decisions in the face of the strong incentives presented by the capital and operating assistance programs. While the federal transit program has largely succeeded in revitalizing a mass transit industry oriented to serving radial suburb to downtown travel, it has failed to stimulate the widespread adoption of proven cost-effective strategies such as preferential lanes, and more market-oriented strategies such as operating minibuses in low density suburban areas.

At the state and local government levels, the decision to establish public transit agencies with responsibility for both policy and operations has largely precluded the consideration of potentially more efficient providers and service types. The incentives created by the federal capital assistance program for public takeover of locally franchised private transit companies undoubtedly had a great deal to do with this decision. As the federal funding role declines, however, several state and local governments have begun to rethink traditional institutional and funding arrangements for mass transit, and to use state and local funds to support more competitive and diversified services tailored to their emerging urban development patterns. Given greater flexibility in federal funding procedures and requirements, state and local governments might well move further in these directions.

Over the past decade or so, the structure of the federal transit assistance program has been shifting gradually away from discretionary funding and toward formula funding. A program that began in 1964 as 100 percent discretionary capital assistance has shifted to roughly one-third discretionary and two-thirds formula, with the formula portion including a significant amount of funding for operating assistance. And even the one-third discretionary portion has begun to include routine allocations to large cities like New York and Philadelphia for major rail rehabilitation projects, and other allocations for major but fairly predictable bus replacement requirements. Probably less than 20 percent of the total funding remains in the discretionary category for the late 1980s. This shift reflects a growing recognition that, as mentioned earlier, the federal government is ill-suited to the role of investment banker for local transit, and better suited to a role of providing technical and financial support for locally driven decisions. In disbursing capital funds for transit, the federal government has encouraged many cities to make major capital investments that they probably would never have made if they had received an equivalent amount of funding under a formula: the Miami Metrorail being a recent notable example. A growing consensus on continuing this shift in the federal role toward formula funding appears to be emerging in recent studies and policy initiatives.

Two arguments are commonly made for the retention of the federal investment banker role: that the federal government has a unique capability to raise the large sums of money needed for major up-front investments in new transit infrastructure, such as new rail lines; and that local governments will under-invest in transit capital facilities if substantial amounts of earmarked capital funding are not provided to them by the federal government. The first argument is difficult to defend in light of the fact that at least two cities, New York and Dallas, have recently raised much larger sums for transit investment than they could ever have hoped to obtain from the federal government. Clearly the means to raise funds for major capital investments exists at the state and local levels, though the political will may be lacking in some cases. This leads to the second argument: that state and local governments are not able to decide what is in their best interest as far as transit investment is concerned. Whether the federal government has a responsibility to try to compensate for these presumed failings is highly questionable. But even if a case can be made for federal intervention, the likelihood of success is probably rather low. In the past, the federal government was unable to prevent several major cities like New York and Philadelphia from neglecting the capital needs of their transit systems, even with a large federal capital assistance program. And in the process, the federal government undoubtedly contributed to wasteful overinvestment in transit facilities in a number of other cities.

A further line of argument for federal involvement in financing local transit infrastructure has been derived from the substantial federal involvement in the urban road system, through the interstate, primary, and secondary road programs. Certainly strong federal support for the construction of interstate and primary roads helped to increase the automobile orientation of U.S. cities, and weakened the viability of urban transit. This impact is more a matter of the past than the future, however: the federal highway program is now more concerned with rebuilding and maintaining existing federally-aided roads than with building new roads, and shows little sign of promoting major expansions in the urban road system. In other words, decisions on urban roads are likely to be made primarily at the state and local levels in the future, with the federal government providing some financial support and technical assistance. Under these conditions, a continuing shift in the federal transit program toward formula funding would appear to be compatible with the likely evolution of the federal highway program.

The gradual growth in federal mandates associated with federal transit funding provides one basis on which to redefine the federal role in urban transit. To the extent that these mandates reflect a valid national interest in urban transit (a contention which might well be reexamined mandate by mandate), the federal government could be called upon to provide funding levels which are commensurate with the costs associated with these mandates. In the highway sector, state governments often speak of a 20 cent cost associated with each federal dollar to cover the costs of federal mandates and restrictions. It may be time to compute a similar figure for the federal transit program, and to compare it with current and proposed levels of federal transit funding.

In summary, the gradual shift in federal transit funding over the last decade away from discretionary and toward formula funding seems to reflect accurately the limited ability of the federal government to serve as a manager of local transit investment and operating decisions. A consensus seems to be emerging for a continuation of this trend, preferably accompanied by a similar trend with regard to the federal role in the urban road system. The federal role might evolve to one of financial support and technical assistance for locally-driven urban transportation decisions, linked to related local decisions on zoning and parking policies. Federal funding levels should explicitly reflect the costs of compliance with federal mandates, and future debate over the federal role should focus on the appropriateness of these mandates as well as on funding levels. At the state and local levels, current interest in reforming institutional arrangements to promote more diverse services and competition in service provision is well-directed, and is likely to increase as greater funding responsibility is assumed by these levels of government. A reformed federal program designed to support and encourage these developments could make a much greater contribution to the expansion of efficient mass transit than a continuation of current arrangements.

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AIRPORTS

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The U.S. system of airports and airways supports what has been the fastest growing mode of public works infrastructure. By and large the system works well. Of our 16,300 airports (more than the rest of the world combined), 6,000 are for public use, mostly by general aviation aircraft (small planes owned by individuals and corporations). Of the 550 commercial service airports, 70 account for 90 percent of passenger traffic, and the top 27 handle two-thirds of airline passengers.

While there is some evidence that the rate of growth in commercial aviation may be slowing (airline revenue as a fraction of GNP has dropped since 1980), the FAA expects passenger traffic and aircraft operations (mostly by general aviation planes) to grow 4.5 percent a year through the end of the century. This will place added pressure on the physical capacity of the system.

Public spending totals some $8 billion annually, roughly 60 percent by the Federal government with most of the balance by local governments and the special districts that own and operate most commercial airports. One third of total public spending is for capital improvements, again mostly for larger commercial airports. This public spending supports, in turn, about $75 billion a year in direct private expenditures on civil aviation services and equipment.

Large and medium-sized airports have good access to the financial markets, and have been self-sufficient for capital as well as operating costs. Typically, these airports have long-term use agreements with the airlines that determine how fees will be charged. With the large number of airline hubs and the recent round of airline mergers, relative power in these negotiations may be shifting back towards the airlines.

Users supply most public funds for aviation -- landing fees and other charges at airports and a series of Federal excise taxes -- most importantly an eight percent tax on airline tickets. Federal tax receipts are paid into the Airports and Airways Trust Fund. Because of disagreements among the Administration and various Committees of Congress as well as efforts to control Federal spending, the Trust Fund has a $5.6 billion uncommitted surplus. Congress is expected to approve a new five-year aviation authorization and excise tax bill in 1987.

The Federal Aviation Administration (FAA) makes about $1 billion a year in airport capital grants, providing roughly one-third of airport capital spending. These grants cover 20 percent of capital costs at larger commercial airports and up to 90 percent at general aviation airports used to help relieve congestion. The FAA spends $4.8 billion a year to operate the air traffic control system, a network of radars, communications equipment, and air traffic controllers who direct and monitor air traffic at 399 airports and on long-distance trips.

Under the $16 billion National Airspace System (NAS) Plan, the FAA is modernizing air traffic control equipment and consolidating facilities. As originally conceived, the Plan was expected to have a benefit cost ratio of 2.3 to 1. With the recently revised cost estimates and the two to three year delay in implementing parts of the system, the overall benefit cost ratio may drop to 1.5 to 1. While still healthy, this makes it especially important that certain key assumptions are not violated -- most importantly the political ability of the Congress to close facilities.

PROBLEMS

The number one aviation problem is congestion, or in its long-term version, a lack of adequate capacity. Last year, the FAA counted more than 410,000 aircraft delays, enough to cost the airline industry $1.5 billion plus perhaps an equal amount in lost time for travelers. Congestion also has an impact on safety. Operational errors by controllers increased 18 percent and near mid-air collisions by 13 percent in the first quarter of 1986 (compared with 1985). The fastest growing part of airport capital needs is that for new capacity, which now totals some 72 percent of FAA's estimate of $24.3 billion in airport needs over the next ten-years.

Other serious problems concern program instability due to budgetary and political interference and questions about management of the air traffic control system. Locally noise remains a serious problem, one that can have a significant effect in limiting the ability to add new airport capacity.

SOLUTIONS

Possible solutions are of three types: changes to the Federal program, pricing changes, and management improvements. The nation's largest airports -- the top 70 that account for 90 percent of the traffic -- are financially independent. Their share of Federal grants (about $400 million) could be dropped. This defederalization option would have only limited economic impact. Remaining Federal airport grants provide primarily local economic benefits, but could be continued based on equity grounds.

Pricing policy can provide a more efficient way to allocate scarce airspace as well as providing a source of funds to expand capacity. *Peak-period charges* have shown great success in encouraging general aviation aircraft to shift to other airports or less congested times at La Guardia and several other major U.S. airports. While by no means a permanent solution, peak-period charges would add to the effective capacity at many airports and defer the need to expand at many others.

While "privatizing" the air traffic control system has considerable theoretical appeal and is likely to improve operations, but it faces severe political problems. A more practical alternative to improve air traffic control management might be to copy the British model and give airports responsibility for local air traffic control operations. Under this "*hybrid model*", the FAA would set safety standards, but local airports would have greater control over the factors that affect capacity and may have greater pricing freedom.

One option involves adding a new source of long-term funds targeted toward the land use and noise easement problems of adding new airports and expanding capacity at existing ones. A *national airport revolving fund* may be the appropriate mechanism to help solve this problem. In order to retain incentives for cost-effective plans, such long-term, low-cost loans should be limited to 20 percent of project costs.

As with other infrastructure modes, relatively little is known about the effect of airports and airways on national (as opposed to regional) economic growth. International experiences point to the potential benefits of comprehensive system audits. Such techniques could prove particularly useful within the air traffic control system where political and bureaucratic problems act as a constraint to program efficacy.

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INTERMODAL TRANSPORTATION

Joseph S. Revis and Curtis Tarnoff

The Intermodal Environment

Intermodal transportation, when it works well, provides the basis for better integrating the transportation network through smoother, quicker and less frequent transfers. In terms of the public's willingness to invest in (and sometimes operate) infrastructure, participation is justified on the basis of two national objectives: (1) stimulating economic growth and development, and (2) (in more recent times) improving the United States' competitive position in world trade. Intermodal transportation contributes to these two objectives by providing greater efficiency and, thereby, reducing transportation costs.

Decreased transportation costs, in reasonably competitive markets, will be translated into a change (increase) in the relative utilization of the resources affected by the lower transport costs. The price-stimulated increase in the use of the relevant resources will generate new or expanded economic activity in the region and/or part of the nation affected by the cost/price change. Through the decreased transportation costs associated with intermodal technology, economic growth and efficiency are stimulated. Through expanded domestic economic growth and efficiency stimulated by intermodal-initiated decreased transportation costs, the international competitive position of the United States is also enhanced.

In terms of the intermodal process, almost every freight or passenger movement involves some form of interruption due to a change of mode. The underlying principle of intermodality is to provide an uninterrupted movement of goods and people from origin to destination. Although never fully realizable, each occasion an interruption is eliminated or a time delay is reduced, the operating, time, accident and pilferage costs will be reduced.

The difficulties of each intermodal transfer will depend on many different aspects of the movement ranging from a transfer within the same company on the same mode (on-line); a transfer within the same company but between different modes (inter-line); or a transfer between different companies and different modes (listed in the order of the difficulty of the intermodal movement). None of these intermodal transfers can be made unless six major elements are present:

- Integrated and coordinated infrastructure
- Integrated and standardized facilities and equipment
- Coordinated communication
- Coordinated management and administration

- Coordinated paperwork (documentation)
- Clarity of liability responsibility

A "mismatch" in any of these intermodal requirements, will result in an increased cost. The objective of intermodal transportation is to eliminate as many of the "mismatches" as possible.

The interacting factors of intermodal transportation are most dramatically revealed in the cities. It is here that the network conflicts are most visible: trucks competing with the automobile and bus for use of the same road and street network--often at the same time of day. Intercity traffic, intracity traffic, rail traffic at the grade-crossings, automobile traffic and pedestrians culminate in a crescendo of congestion. And not just on the roadways. Passenger and freight terminals are equally congested at the bridges and tunnels. Control and coordination of these goods and passenger movements is a major objective of urban planning; an objective that is not always modally well-coordinated.

Major Issues and Recommendations

Review of the relationship between transportation public works and intermodal transportation does not reveal any major investment requirements for intermodal transportation that need to be separated from each of the transport sectors as a whole. By and large, the major problem associated with intermodal transportation is the fact that intermodal impacts and considerations are not adequately taken into account. There is a significant gap in intermodal coordination at the urban and national levels in important issue areas in which national and regional growth and development objectives are affected. The recommendations that follow are structured around these issue areas.

1. Intermodal Coordination

Perhaps the most important conclusion that emerges from this review of intermodal transportation is the lack of intermodal coordination. Unlike other public infrastructure, the problem is not unmet investment needs or unbuilt facilities or capacity. It is the lack of a central focus point where the national implications of intermodal transportation can be taken into account. A federally centralized agency could provide direction and initiative for many intermodal activities for which only the federal government can take the lead. States tend to have the same problem, and though there are states that have intermodal programs, these are the exceptions. Most states have no program. Ideally, a centrally coordinated network of intermodal agencies linked to the private sector would provide an ideal base from which national policy on intermodal transportation could be developed.

Recommendation:

In order to assure that intermodal issues receive coordinated consideration, it is recommended that a nationally centralized focus be developed with a specific agency or focus of responsibility assigned within the federal government. The primary objective of the agency would be to identify national intermodal needs and policies, and stimulate and promote intermodal transportation consistent with national objectives and policies. Indicated functions include:

- Encourage an integrated and coordinated port access/urban planning process as a means of assuring the development of a systemic and intermodal approach. An integrated approach would include not only port access but state and local infrastructure programs as well, including terminals (freight and passenger) and urban goods and passenger movement planning generally.

- Provide leadership in the development of intermodal standardization.

- Undertake an information collection and dissemination program to develop an intermodal transportation data base.

- Initiate and stimulate research and development on intermodal transportation. As part of this program, prepare a research and development agenda.

- Undertake studies on the relationship between intermodal transportation and national policies in growth and trade, and serve as an ombudsman.

- Monitor and evaluate the interacting intermodal impacts on public works infrastructure in transportation and identify needs in terms of design standards.

Although details for the specific organization arrangements required to implement the program just described will have to be filled in, the broad outline for such an organization readily suggests itself. In order to assure a balanced intermodal program, it will be necessary to include four basic areas of intermodal transportation: policy, planning, program and research. Since the Secretary of Transportation has primary responsibility for national transportation policy, the

Secretary's office is the operationally logical location for an organization designed to carry out the programming, planning and research aspects described above.

To carry out these programs, it is recommended that a dual organizational structure be developed: (1) an Office of Intermodal Transportation Coordination reporting to the Secretary, and (2) a Productivity Council on Intermodal Transportation Coordination. The Office of Intermodal Transportation Coordination would be directly responsible for carrying out the functions described above, and would also provide Secretariat and staff support to the Productivity Council. The Productivity Council would provide a forum for participation by modal and related third party representatives from both the private and public sectors including state and local representation. An important function of the Productivity Council would be to develop a coordinated intermodal transportation research program that is operationally oriented towards increasing productivity. In this context, representation and/or participation by a broad range of transportation oriented research organizations will be essential.

2. Standardization and Design Standards

For intermodal transportation, the most important design standard issue is developing standardized designs to expedite and stimulate intermodal transfers. The standardization issue covers domestic and international freight and passenger movements, and includes equipment (such as containers, handling equipment, rail cars, trucks, cranes); the rights-of-way used by each of the modes (navigation channels, inland waterways, canals, highways, streets, tunnels and bridges and rail rights-of-way); and terminal designs --the latter linked to the passenger transfer needs of intracity, intercity domestic and international passenger traffic.

Recommendation:

Efficient intermodal transportation requires that standardized equipment and documentation be available in order to minimize delays. Given international and domestic content of intermodal transportation, it is recommended that the federal government take the leadership to promote and assist in the development of intermodal standardization covering both international and domestic needs. Standardization efforts should cover all aspects of the intermodal network including:

- Containers and Related Equipment
  - Domestic/International Containers
  - Air Freight Containers

- Vehicles and Related Equipment
  - Cranes and Handling Equipment
- Rights-of-Way
  - Rail Clearances
  - Highway Clearances
- Communication, Information and Computerized Data-Base Formats

3. Documentation and Facilitation

No cargo movement or passenger trip can be made without its accompanying documentation. The customary "waybill" follows from origin to destination, and third-party support is often needed to facilitate the movement of documents, without which nothing else will move. In that context, efficient and simplified documentation is essential for intermodal transportation to work. As noted earlier, without coordinated documentation, intermodal transfers become intermodal mountains to be climbed, and the connection between coordinated paperwork and liability, communication and management control is obvious.

To some extent, documentation is a part of the issue of standardization, especially when international clearances of containers, breakbulk cargo or passengers are concerned. However, because of its special importance to intermodalism, it has also been identified as an issue warranting separate treatment. When combined with the liability problems associated with intermodal transfers, the need to develop uniform and simplified documentation becomes even more apparent.

Recommendation:

Because of the special problems associated with intermodal documentation and its central importance to assuring efficient and timely intermodal transfers, it is recommended that a documentation subgroup be organized as part of the standardization effort recommended above. The documentation program should focus on encouraging the development of uniform doqumentation including both the international and domestic networks. In addition, the program should consider and propose approaches for dealing with the liability problems associated with intermodal movements.

4. Labor-Management Relations: Institutional Obsolescence

Realization of the productivity increases and the benefit of scale economies is very dependent on manning requirements and work rules. The basis for present labor-management relations is rooted in a statutory and regulatory regimen that emerged from the technologies and institutional needs of the Thirties. Labor-management mechanisms are being used for technology and economic activities profoundly different.

Modal managers regularly identify work rule problems as a major constraint on realizing the full productivity potential of new technologies; conversely, the problem of job and income loss resulting from the new technology is identified as a major concern of the labor force. Every cycle of innovation and its accompanying technologies is marked by a period of transition during which time adjustments are made to bring institutions into alignment with the new technology. This usually means new jobs and retraining but these solutions do not work for everyone, and in any case, take time -- time not available to some parts of the labor force. The issue is therefore, how to minimize or eliminate institutional constraints that limit the productivity increases associated with intermodal technology on the one hand, while providing equitable displacement solutions on the other hand.

Recommendation:

In view of the vital importance to the National economy of ensuring that the benefits of the new technology are not constrained, it is recommended that a special task force or study commission be organized to reexamine the institutional structure of labor management relations and the bargaining process in order to identify new approaches that would encourage productivity while at the same time providing for an equitable and fair transition for moving from an older technology to a new technology.

- Consideration of current legal/regulatory origins and practice.
- Identification of current labor-management practices and their impact on productivity, employment and income.
- Identification of alternative equitable approaches for improved labor-management relations that also maximize the productivity contributions of new technology (including foreign experience)
- Development of a phased program for implementing needed changes.

5. The Urban Interface

In U.S. urban areas, intercity intermodal transportation movements interact with the intracity goods and persons movements. Freight pickups and deliveries within the region compete with the automobile and transit passenger trips for access to the same roads, streets, terminals, loading platforms, curb space, parking spaces, tunnels and bridges. If there is a port in the region, the competition for access is compounded.

Urban and regional planners generally consider these problems as part of their overall planning effort. Nevertheless, an integrated and coordinated intermodal perspective is often not adequately included when planning intermodal linkages.

Recommendation:

Experience in cities that have used an integrated approach indicates that substantial benefits result in terms of a lower level of public works investment needed to serve urban intermodal passenger and goods movements. Therefore, it is recommended that a coordinated intermodal approach be required for all urban projects involving intermodal or multimodal facilities funded by public funds. This program should include not only freight but passenger terminal facilities in order to keep the amount of terminal investment required to a minimum, and provide for convenient intermodal transfers.

Furthermore, it is recommended that the federal government disseminate approaches, methods and case study examples illustrating effective coordination through seminars, workshops, training programs, and other information transfer techniques.

6. Data Base Development and Dissemination

Efforts to collect, for this report, data on the volume, origins and destinations, levels of expenditures, the types of goods and the costs of intermodal transportation were unsuccessful. There is a significant lack of the type of information needed by the public sector to make policy and program decisions and by the private sector for planning and evaluation of future intermodal potentials. Discussions with modal and public sector representatives confirms the high priority assigned to developing intermodal information data bases and dissemination programs.

Recommendation:

It is recommended that an intermodal transportation data base be developed covering all modes. It is further recommended that Users Conferences similar to those of the Census Bureau be organized as the basis for identifying the nature and priority of the data base needed. The data base should be prepared and made available on a regular basis, and responsibility for the development and management of the data base assigned to the U.S.

Department of Transportation with coordinated links to state and local governments, the private sector and other users. Basic information elements should include:

- Volume data on intermodal transportation by a relevant classification system (bulk, breakbulk, container, etc.).
- For the specified classification system, identify the patterns of movement in terms of origins and destinations by modes separately and combined.
- Public investment in intermodal facilities and transportation services by level of government and estimates for the private sector.

7. Urban Coordination for Passenger Facilities

Major intermodal passenger transfers take place at terminals involving intercity bus, rail and air terminals. In addition, there are intracity terminals related to public transit stations and regional bus and commuter rail services.

These terminal facilities are typically designed and located in accordance with the specific needs of the mode in question. If private services are involved, separate terminals may be built by each provider -- e.g., intercity bus terminals. In order to keep the amount of terminal investment required to a minimum and provide for convenient intermodal transfers, it is essential that terminal locations and designs incorporate intermodal requirements during the planning phase.

Recommendation:

It is recommended that the federal government, in coordination with state and local governments and private transportation providers operating in urban areas, take the leadership to provide for assuring that intermodal passenger facilities needs are integrated into the urban transportation planning process, particularly where new facilities are under consideration.

8. Research and Development

A review of intermodal transportation has identified a significant number of research and development issues. Public and private participation is needed., not only to identify an appropriate R&D agenda but to assist in the research and help test and evaluate field applications.

Recommendation:

It is recommended that the federal government take a leadership role in developing a research agenda for intermodal transportation covering the needs of intermodal transportation and their impact on the national economy.

From the viewpoint of the public works infrastructure program in transportation, the research and development agenda should focus on those research areas in which a public role is appropriate, and on issues affecting national infrastructure policy objectives. In that context, the following areas suggest themselves for consideration.

- Standardization and Documentation
- Computerization and Applications
- Data Base Needs
- Intermodal Technology
- Institutional Obsolescence: Labor-Management Relations
- Urban Intermodal Planning
- Intermodal Passenger Terminals
- Intermodal Transportation and Competition

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WATER

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WATER RESOURCES: THE STATE OF THE INFRASTRUCTURE

Kyle Schilling, et. al.

Water resources programs have matured and their focus is changing from development to operating and maintaining existing facilities. At the same time, responsibilities simultaneously are shifting from the Federal to non-Federal sectors to fund, operate, innovate, and manage on a proportionately larger basis than in the past. These shifts in emphasis and responsibility necessitate adjustment of institutions and approaches.

Current performance levels of existing water resource systems are difficult to determine in the aggregate. However, it appears that while physical and financial needs exist throughout this category, three areas merit special concern: urban stormwater management, safety of non-Federal dams, and shoreline erosion, an emerging problem relating to climate change.

Water resources needs that can be identified do not necessarily represent significant new levels of Federal effort--although the scope of certain problems, such as urban drainage, may be nationally significant. However, state and local capability will continue to be a major concern, as they seek to manage added responsibilities and as water resources compete with numerous other public programs for funds and support under conditions of budgetary constraint. Service providers at all levels must recognize and adapt to changed circumstances requiring more attention to operation and maintenance, rather than to new development.

Capital spending by all government for water resources has fallen by 60 percent since the late 1960s. Conversely, operating expenditures have increased. Debt and non-debt financing appears to be used equally today to finance non-Federal investments. In the category of debt financing, general obligation bonds are the principal source of construction funds for state governments, while construction at sub-state levels. In terms of non-debt financing, local governments use general revenues primarily for operating expenses, while states make combined use of such current revenue sources as general tax receipts, user fees, and special assessments.

Implementation of the Water Resources Development Act of 1986 is expected to result in greater non-Federal involvement in certain decisions, which are projected to reduce the size and overall investment needs of future Corps of Engineers projects. In this process, state and local governments will assume a larger effective financial burden than in the past, while Federal investment needs will stay the same or decrease slightly.

The ability of state and local governments to provide adequate revenues for future spending will depend greatly on establishing institutional and financing approaches that move away from reliance on current revenues or general obligation debt and towards strategies that adequately link project beneficiaries with the cost of services that they receive, whether through revenue-bonding, usage fees, special assessments, or other options.

With the exception of some service contract arrangements, privatization of water resources in the broad sense (i.e., use of private capital to accomplish public purposes) today is limited. Moreover, additional opportunities are limited because the nature of some services is not conducive to privatization, and there is relatively little need for new development in which the tax benefits of privatization might be realized.

The following table summarizes the study's findings concerning primary funding responsibility and likely direction of future funding needs for these six service areas. Necessarily, this table generalizes about a wide diversity of services and ownership/management responsibilities. While the table summarizes the services in terms of public responsibility, many of the categories involve considerable private sector activity. Thus, points in the table which read "local" or "state/local" should be understood to include "local/private" or "state/local/private" in many cases.

Recommendations. The study's findings regarding physical condition, needs, and services in the water resources category lead to seven recommendations. The recommendations focus on institutional and information concerns that underlie adequate provision of physical structures for water resources services.

1. There is need to establish an intergovernmental coordinating forum for information and technology transfer. The thrust of this effort would be to accelerate institutional adaptation from new development towards management of existing systems. This forum should lead in developing procedures to consider benefits and costs, risk and alternative performance levels for existing structures. These procedures will supplement similar ones which exist for new development and lead to improved future needs assessments.

2. Institutional changes should be pursued by each level of government to improve management and financial decisionmaking of existing service facilities. All levels should establish capital budgeting procedures which provide long-term programmatic and financial planning, set priorities within budget constraints. and improve rate setting and revenue generation practices.

SUMMARY TABLE: PRIMARY FUNDING RESPONSIBILITY AND FUTURE NEEDS

	Primary Funding Responsibility			Are Future Needs Mainly
	Construction	Rehabilitation	O&M	For Capital or O&M?*
Ports				
Navig. Facilities	Federal	Federal	Federal	O&M
Landside**	Local	Local	Local	O&M
Inland Navigation				
Navig. Facilities	Federal	Federal	Federal	O&M
Landside**	Local	Local	Local	O&M
Flood Control***	Federal	Local****	Local****	Capital
Urban Drainage	Local	Local	Local	Capital
Dam Safety	N/A	Local	N/A	Capital
Shoreline Protection***	Federal	State/local	State/local	Capital

* "Capital" means investments in new construction and/or major repair and rehabilitation. "O&M" means normal maintenance of existing facilities.

** Although some states are involved in providing landside facilities at ports and waterways, local governments and the private sector have primary responsibility.

*** Solutions to flooding and shoreline erosion problems should be recognized as including many non-structural elements such as flood plain and coastal zone management policies and programs.

**** Typically local, but some States such as California are exceptions.

3. An assessment by Federal and state entities should be conducted of condition of levees and floodwalls. Safety concerns are similar to those for dam safety; design, maintenance, and rehabilitation practices are believed to vary as widely as they do for dams.

4. Improved data should be developed to determine the extent of urban drainage/stormwater management needs. Each level of government has a role to play in fostering and implementing management practices, as well as developing complementary stormwater and flood control practices.

5. There is need for continuing study at Federal, state, and local levels of subsidies which influence project size or project choice and policies that favor new construction over maintenance and rehabilitation. These policies and factors influence needs and financing estimates, decisionmaking processes, and liability considerations.

6. Improved techniques should be developed to identify project beneficiaries, in order to achieve "user pay" objectives. Information gained on where potential beneficiaries are located will help better size, phase, and configure projects to meet budget constraints.

7. Conditions under which projects were originally built change, as do perceptions of priority of services they provide. Some changes may be anticipated, others are inherently less predictable, such as global climate change which may drastically alter future supplies of water resources and services needed. Federal and non-Federal interests should collaborate to improve procedures for adjusting to and anticipating uncertainties that may affect physical structures.

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WATER SUPPLY

Wade Miller Associates, Inc.

The provision of high quality water for human consumption and industrial use is a major component of our nation's physical and economic well being. This report examines issues, problems, and emerging trends related to water supply infrastructure as a service delivery function. Based on this analysis, conclusions and recommended government policy options are presented, and potential subjects for additional research are identified.

The water supply industry is characterized by a long history of self-sufficiency and local government control over management and finances. In recent years, however, the ability of private utilities and local governments to provide adequate and affordable supplies of safe, potable supply of water has been questioned. The purpose of this study is to determine what actions, if any, may be taken to improve the efficiency of water supply capital investment and to ensure that projected water supply infrastructure needs are met.

The report evaluates several recent studies of national water supply investment needs and examines their conclusions pertaining to the ability of water utilities to pay for these projected needs. Existing and potential roles of the Federal, state, and local governments in the water supply industry are examined. The relationship of water supply and economic growth, particularly as it pertairs to industrial water use, also is discussed.

This study explores traditional and innovative mechanisms available to ensure that water utilities meet their projected needs. Specific areas of study include innovative technologies and technological research; public/private partnerships in water supply; finance mechanisms and access to the credit market; and water supply management programs in Western Europe and Japan.

Major Findings

- A national water supply "infrastructure gap" of the magnitude that would require a substantial federal subsidy does not exist. Water utilities experiencing revenue shortfalls generally do not charge rates which cover full costs of the utility.

- While there is an infrastructure problem of considerable magnitude in some (primarily northeastern) cities, urban water supply systems as a whole do not constitute a national problem.

- A national problem does exist for small water systems. The majority of small water systems are poorly managed due to 1) a lack of understanding of the water supply function, 2) lack of technical training, 3) inappropriate rates structures, 4) lack of access to capital, and 5) no economies of scale.

- The proper implementation of the Safe Drinking Water Act Amendments will have significant impacts on both water utilities and state public water supply supervision programs. The primary costs and workload impacts will be felt by medium and smaller systems.

- There appears to be sufficient water available in western states, but due to allocation practices, water resources are not distributed efficiently.

- Contamination and depletion of groundwater supplies is a major problem facing the water industry. Additional costs can be expected to result from groundwater protection and reclamation activities.

Recommendations

- **Full-Cost Pricing** -- There should be a national mandate to require water utilities to be financially self-sufficient through water rates. This could be achieved through amendments to the Safe Drinking Water Act.

- **Expanded Emphasis On Regionalization** -- At the federal level, leadership in managing regional water resources must be re-directed somewhat from the traditional emphasis on source development and focused instead on the problem of efficient allocation. At the state level, many opportunities to promote regional management exist; these opportunities should be explored.

- **Expanded Research And Technology Transfer Agendas** -- The research and technology transfer programs of the Environmental Protection Agency and the American Water Works Association Research Foundation should be expanded to encompass a broader range of subject matter more relevant to the needs of small water systems and covering routine system management functions as well as sophisticated technologies.

- **Short-term Emphasis on Technical Assistance at the National Level** -- Currently, the National Rural Water Association operates a technical assistance program in 34 states. Given the severity of small system problems, the NRWA program should be expanded to 50 states; the program should be coordinated closely with state drinking water programs, however, to achieve maximum benefits and to ensure that truly needy systems are targeted.

- **Expanded Public Education** -- The Environmental Protection Agency, the state primacy agents, and local utilities should initiate a program of "public outreach" to ensure that the citizenry is cognizant of important developments in the drinking water field.

Potential Council Research

- Convene a workshop of experts in the field of water pricing to further evaluate the plausibility of a national mandate for full-cost pricing. The output of such a workshop would be a draft of a specific proposal for consideration by the Congress and the Executive Branch.
- Coordinate the development of a national policy agenda for resolving the deficiencies related to technology and its uses in water supply.
- Conduct research on mechanisms to resolve the financial and management problems of small water systems.
- Convene a workshop of state water management officials to explore ways of maximizing the effectiveness of state leverage through coordination of water resources management, public utility regulation, drinking water regulation, financial assistance, and local government regulatory functions.

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WASTEWATER

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About $12 billion annually is spent to construct, operate, and maintain municipal wastewater treatment facilities. In 1986, the approximate 16,000 wastewater treatment facilities served the public by removing over 85 percent of the pollutants from wastewaters generated by 70 percent of the U.S. population and about 160,000 industries before discharging the treated wastewaters into waterways. Reducing wastewater discharges protects public health and the environment. Localities that can provide adequate wastewater treatment capacity attract development and associated economic growth.

In 1972, Congress enacted a strong Federal program to reverse growing and severe pollution in U.S. waterways. The program included: setting ambient water quality standards to protect designated uses in all the nation's waters, issuing discharge permits with strict removal requirements to municipal and industrial dischargers, developing regional and statewide plans for managing water quality, and providing Federal grants for the construction of local wastewater treatment facilities. Between 1972 and 1987, Congress shifted the responsibility for operating the pollution control program to the states with Federal oversight. By 1990, Federal grants for local wastewater treatment plant construction will be replaced by loans from state revolving funds (SRFs) capitalized by the Federal government and the states. Throughout this shift in program responsibilities local governments provided wastewater treatment services. The change from grants to loans will increase state and local financial responsibilities and could require users to pay more for wastewater treatment.

Significant improvements in wastewater treatment services have occurred since 1972, but the following issues remain:

- Significant Costs Remain to Provide Needed Wastewater Treatment. Financing the new construction and expansion of the thousands of facilities necessary to meet national goals will impose new financial burdens on states, local governments, and ultimately on users.

- Many Wastewater Treatment Facilities do not Charge Full Cost for Service. Wastewater treatment services priced below costs promotes excess demand, inflated needs estimates, and may not provide a sufficient stream of revenue to support new debt or to set aside retained earnings for later investment in improved plant or equipment.

- Wastewater Management Regulations Could be More

Flexible. Additional flexibility in local water quality control strategies could continue the progress in cleaning up the nations waterways, but at less cost.

- Areawide Planning Needs to be Re-evaluated. A lack of coordinated areawide water and economic planning could lead to inefficient wastewater management.
- The Pretreatment Program is Critical to Controlling Toxic Wastes. The pretreatment program administered by the EPA and the states has not been fully implemented, and as a result, some U.S. waterways receive high amounts of toxic wastes.
- Research, Development, and Operating Innovations Have Been Slow. The nation has not yet committed to an ongoing research program targeted to low cost technologies or the large and growing costs to operate and maintain wastewater treatment plants.

Concern for these issues suggest the following policy recommendations that could further improve wastewater treatment services:

- Promote Improved Financial Management. A greater number of facilities could be operated on a utility basis (operate on their revenues) to encourage greater local financial responsibility by localities.
- Develop More Flexible Limits for Wastewater Discharges. Innovative permits could reduce the cost to nation of removing pollutants from wastewater.
- Incorporate Water Quality, Water Supply, and Economic Development Into Areawide Planning and Management. Areawide planning and management agencies, which consider all water uses and regional growth, could provide more economical wastewater treatment services.
- Accelerate the Pretreatment Program to Control Toxic Substances. Expanded program implementation and additional technical guidance and information on pollutant sources could improve the control of toxic substances discharged into waterways.
- Improve Wastewater Treatment Technology, Operations, Cost Control, and Research and Development. Regional or statewide technical and financial assistance programs could provide research on low-technology treatment, train operators, and encourage the use of

numerous strategies to save in plant operating costs.

As indicated by the environmental legislation enacted since 1972, there is a consensus in the U.S. for a healthy and aesthetically enjoyable environment. The cost of protecting the environment will be significant, but all of the policy recommendations presented above could increase the efficiency of providing wastewater treatment services, and, consequently, reduce the cost of protecting the nation's waters.

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WASTE

SOLID WASTE

Jeffrey F. Clunie, R.W. Beck and Associates

Solid waste management in the United States can generally be broken down into two general categories of public works involvement: (1) the collection and transportation of municipal solid waste; and (2) the disposal of municipal solid waste. Because this country is confronted with a crisis regarding the disposal of solid waste, this Report has focused its primary attention on the problem of where to put it down, once it has been picked up.

Purpose of Report

The purpose of this Report is to identify: (1) the current status of solid waste management in this country; (2) the roles being played by Federal, state, and local governments in dealing with solid waste management; (3) the current problem areas in solid waste management which require immediate attention; (4) the need to construct and maintain the infrastructure necessary to deal with solid waste management; (5) broad policy recommendations to help deal with solid waste management; and (6) specific recommendations regarding more detailed aspects of solid waste management.

Scope of Report

This Report has been prepared in accordance with the contract for consulting services dated January 30, 1987 between the National Council on Public Works Improvement (the "Council") and R. W. Beck and Associates. The Report follows the outline developed by the Council and addresses the following basic areas:

I Current Description of Solid Waste Management
II Evaluation of Public Works Needs
III Innovative Technologies and Practices
IV The Roles of Government
V Infrastructure as a Tool of Economic Growth
VI Privatization
VII Finance
VIII International Perspective on Public Works
IX Findings and Policy Recommendations

Summary

The extent of the waste disposal problem in this country cannot be overemphasized. Approximately 450,000 tons of waste are being generated every day, 95 percent of which are being disposed in landfills that are rapidly reaching the end of their disposal capacity.

The development of a national policy regarding solid waste management is needed if a disposal crisis is to be averted and effective management of wastes is to occur in the United States. The management approach under this policy will entail a series of solutions, all of which may vary in different communities across the nation. The basic priorities, however, should be as follows:

- Reduction in the amount of waste generated or waste minimization;
- Recovery of materials and/or energy; and
- Treatment and/or disposal of residuals.

Efforts to implement the first priority, by reducing the amount of solid waste being generated, will require the implementation of a national policy outside the public works area since it requires basic changes in the way materials are manufactured and packaged for sale.

The second and third priorities involve undertaking policies that will be capital intensive and much more expensive to operate than the current method of solid waste management. It will involve a major investment by both the public works and the private sector in highly engineered landfills and waste-to-energy facilities. The recycling of materials will require specific legislation, special tax, and direct subsidy considerations to ensure that materials are recovered and reused.

The focus of this policy will be to reduce the amount of waste produced, recover what can be recycled, reclaim energy, reduce and reuse the remaining portion to the greatest possible extent, and to landfill the minimum possible amounts.

There are two principal means of waste disposal currently available to solid waste management officials: sanitary landfills and resource recovery or waste-to-energy facilities which incinerate solid waste and produce energy in order to help reduce landfill costs. Furthermore, recycling is becoming an increasingly important means of reducing the quantity of solid waste requiring disposal, and more communities are considering composting as a supplement to landfilling or incineration. Because of a series of environmental concerns on the part of the public, primarily related to siting, it is extremely difficult for solid waste management officials to site either a landfill or a waste-to-energy facility. The potential environmental difficulties associated with a landfill include contamination of groundwater supplies by leachate from the landfill, contamination of surface water supplies by run-off from the landfill, migration of landfill gases, wind blown litter and debris, and the existence of vermin. Environmental concerns with waste-to-energy facilities currently revolve around questions related to air emissions, such as dioxins and acid gases, and the existence of toxic elements in the residue ash.

These environmental concerns have impacted solid waste management officials in two ways. First, the amount of time and effort required of solid waste management officials to site and place into operation either a sanitary landfill or a waste-to-energy facility is now measured in terms of years. Developing a sanitary landfill requires the following: finding a suitable site, performing geotechnical and hydrogeological tests, preparing an environmental impact report, obtaining public approval, designing the facility, issuing long-term bonds to finance the facility, obtaining bids from contractors, undertaking site development work, installing all required equipment, and developing a plan for closure of the landfill and post-closure monitoring. These efforts can often require four or more years before a sanitary landfill is prepared to accept municipal solid waste for disposal.

The development of a waste-to-energy facility by a solid waste management official involves all of the aforementioned steps as well as the following: negotiating a long-term energy sales agreement, selecting a vendor to construct and operate the facility, negotiating construction and operating contracts with the vendor, implementing solid waste flow control ordinances in order to assure a stable supply of waste, negotiating long-term contracts for the delivery of municipal solid waste, and monitoring a two- to three-year construction period. This has resulted in numerous situations where the implementation of a waste-to-energy facility by a solid waste management official can take seven or more years between the time an initial feasibility study is prepared and the first ton of municipal solid waste is processed.

The second significant impact on solid waste management officials is the increased cost of solid waste disposal. Communities that, ten years ago, were paying an artificially low disposal or tipping fee of $3 or $4 per ton in an open dump are now looking at disposal fees at sanitary landfills of $20 or more per ton of solid waste, and the disposal fees at waste-to-energy facilities often range from $30 to $50 per ton, depending upon the value of the energy being sold. These significantly increased costs of solid waste disposal are coming at the same time that solid waste management officials are facing increased demands for capital funds for other sectors of the infrastructure, such as water and wastewater treatment facilities, roads, and highways.

As a result of the increased siting problems and escalating costs, more communities are placing an increased emphasis on recycling as a part of the total solid waste management plan. The principal benefit of recycling is to reduce the amount of solid waste which must be disposed. The goals of voluntary and mandatory recycling programs aim at recovering anywhere from 15 to 40 percent of the waste stream, with some communities reporting recycling rates of 20 to 25 percent.

Some progress is being made in other areas of solid waste management planning, including an increased emphasis on reducing the amount of household hazardous waste being introduced into the waste stream and developing alternative technologies, such as circulating fluidized bed facilities and composting. However, none of these efforts will eliminate the ultimate need for a sanitary landfill to dispose of (1) municipal solid waste which can neither be recycled nor processed at a waste-to-energy facility; (2) the bypass of municipal solid waste from other disposal facilities due to such facilities being down for repairs; (3) the bypass of that quantity of solid waste which exceeds the waste processing capacity of other waste disposal facilities; (4) residue ash from the incinerator boilers of waste-to-energy facilities; (5) the heavy inorganic portion of municipal solid waste from composting facilities; (6) street sweeping solids; (7) leaves and tree trimmings; (8) demolition wastes; and (9) sludge from wastewater and water treatment facilities. Therefore, the public must be made to understand that this country will always have some need for a sanitary landfill. The efforts of solid waste management officials must center not on eliminating sanitary landfills but, instead, focusing on reducing the amount of material which must ultimately be landfilled and assuring that such landfill is designed to meet all environmental requirements.

Solid waste management officials are not confronted with a problem which has no technical solution. Sanitary landfills can be designed, constructed, and operated to collect and treat leachate and methane gas so the landfills will meet environmental requirements. Similarly, waste-to-energy facilities have demonstrated that they can be made to incinerate municipal solid waste so it can be reduced by 90 percent on a volumetric basis and 75 percent on a dry weight basis, while generating energy for sale and meeting existing environmental standards. Recycling programs have demonstrated that 15 to 20 percent of the waste stream can be recovered.

Rather, one of the biggest problems which a solid waste management official must contend with is related to information.

This refers to three primary informational areas:

1. Information and guidelines from regulatory agencies regarding the environmental standards which must be met.
2. Information and actual test data regarding the environmental impact of such items as leachate, landfill gases, dioxins and possible toxic elements in residue ash.
3. Most importantly, information for dissemination to the general public to inform them of the necessity of providing the service of solid waste management with all of its various components. This might include information regarding the fact that the waste disposal problem cannot be made to disappear, that sanitary landfills must be sited and approved, that active citizen participation is the only way that materials can effectively be recycled and household hazardous waste can effectively be removed from the waste stream, that all efforts are being made by solid waste management officials to deal with the environmental problems, and that solid waste management is going to be increasingly expensive if we are to protect the environment.

The solid waste management "industry," including the public and private sectors as well as the regulators, has had limited success to date in these three informational areas. Increased efforts at public education and information must be made at all levels of government and the private sector in the solid waste management area. Citizens must be made to understand the nature of the problem they are generating every day; as a society, we can no longer afford to maintain the attitude of "After it goes out to the curb, it is somebody else's problem." The general public must understand that each of us must be a part of the solution to the solid waste disposal problem and that such involvement must include: (1) recycling materials that can be put to further economic use; (2) segregating such household hazardous waste as insecticides, automobile batteries, and lead paint and bringing them to collection centers for proper disposal; (3) accepting the inevitable fact that solid waste management will cost more if the environment is to be protected; and (4) accepting the fact that the environmentally sound disposal of municipal solid waste will require the location of a waste disposal facility somewhere within the community or regional area.

Solid waste management is a local problem which, in most cases, is being dealt with at the local level, either within the specific community or on a regional basis. Solid waste disposal facilities, both landfills and waste-to-energy facilities, are capital intensive, costing millions of dollars. However, because solid waste management allows for relatively simple identification of the users of the service, it is possible and necessary to develop a system of users' fees such that this portion of the infrastructure can be made to be financially self-supporting. The needed capital to construct waste disposal facilities can be provided by the existing capital markets without the need for grants or subsidies from higher levels of government. These abilities, when combined with the need for certain specialized technical expertise, result in a situation where privatization has and will continue to play a very important role. Solutions to the technical and financial problems are already available: answers to the siting, environmental, and informational problems require additional effort on the parts of all involved entities.

While local government will continue to take the lead in most facets of solid waste management, it will require assistance from the Federal and state levels, particularly if an effective national policy of reducing the amount of waste generated and recycling the maximum amount of material is to be implemented.

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HAZARDOUS WASTE

Kenneth Rubin, Apogee Research, Inc.

The goal of U.S. policy in hazardous waste control programs is to protect human health and the environment at the lowest cost to the nation. Two national programs help achieve this goal: the regulation of currently generated industrial hazardous wastes under the 1976 Resource Conservation and Recovery Act, and the cleanup of accidental spills and past mismanagement of hazardous wastes on the land under the 1980 Superfund statute. The scope of each program is substantial -- U.S. industries generate more than two tons of hazardous waste each year for every person in the country and the estimates of the cost to clean up abandoned and contaminated waste disposal sites run as high as $100 billion. Both programs were recently overhauled to take account of disappointing progress made under their early years.

Protecting the nation from the health and environmental risks of hazardous waste will require more rigorous application of current control programs and the introduction of several new ones. The nation faces the following general problems in this regard:

- The Nation has missed the opportunity to reduce the generation of hazardous waste. Regulatory strategies have focused on controlling hazardous waste once it has been generated. As a result, industry has responded mostly with end-of-pipe waste treatment and disposal compliance strategies;

- The Congress has set ambitious regulatory schedules to implement waste control programs. If the EPA misses these deadlines, as they have in the past, the public perception of government's ability to manage the nation's hazardous waste problem will be further eroded;

- Adequate future capacity of waste management facilities is not assured. Although the data are not complete and much uncertainty obfuscates estimates of demand, it appears that treatment shortfalls could arise;

- The nation has not found the institutional solution to site needed new waste management facilities. Faced with strong local opposition to waste management facilities, the states face the formidable task of assuring the proper management of hazardous waste in the future; and

- While effects on the economy have been small, the cost of hazardous waste control is growing. Many expect marginal businesses to close, industries to consolidate, and production shift to overseas.

These concerns suggest six areas where improvements over current policy could result in more assured protection of public health and the environment:

- Strengthening the roles of government by setting realistic regulatory milestones, meeting them, and enforcing programs rigorously;
- Promoting waste reduction with economic incentives, improved information on waste generation and technological opportunities to reduce waste, and government-supported research and development on operating procedures as well as new technologies to reduce waste;
- Improving facility siting processes by establishing the federal role in siting, adopting the most promising state siting initiatives, including local governments in new waste management planning activities, and promoting public/private partnerships for waste control;
- Advancing control technologies through research and development supported by waste-end taxes, government grants, or commercialization guarantees;
- Improving the economic efficiency of regulatory programs with risk/cost or benefit/cost analyses in rule making, alternative regulatory compliance strategies, accounting for future land use in Superfund clean up decisions, local waste control planning, and increased reliance on performance standards; and
- Relieving financing and financial assurance constraints, especially for small businesses with public financial support to promote waste reduction in small plants, the promotion of centralized waste collection and recycling or treatment facilities, the formation of a joint public/private study group to reassess EPA's financial assurance policies, and state environmental impairment survey programs.

Many of these options hold considerable promise toward the goals of protecting public health and the environment. But the costs of proper hazardous waste control will impose economic stress on some industries. Moreover, demands on the public sector to enact programs and equitably enforce regulations will continue to grow. The public-at-large will have to make a commitment to accept the cost of waste management as long as they demand the industrial products that inevitably result in the generation of some waste.

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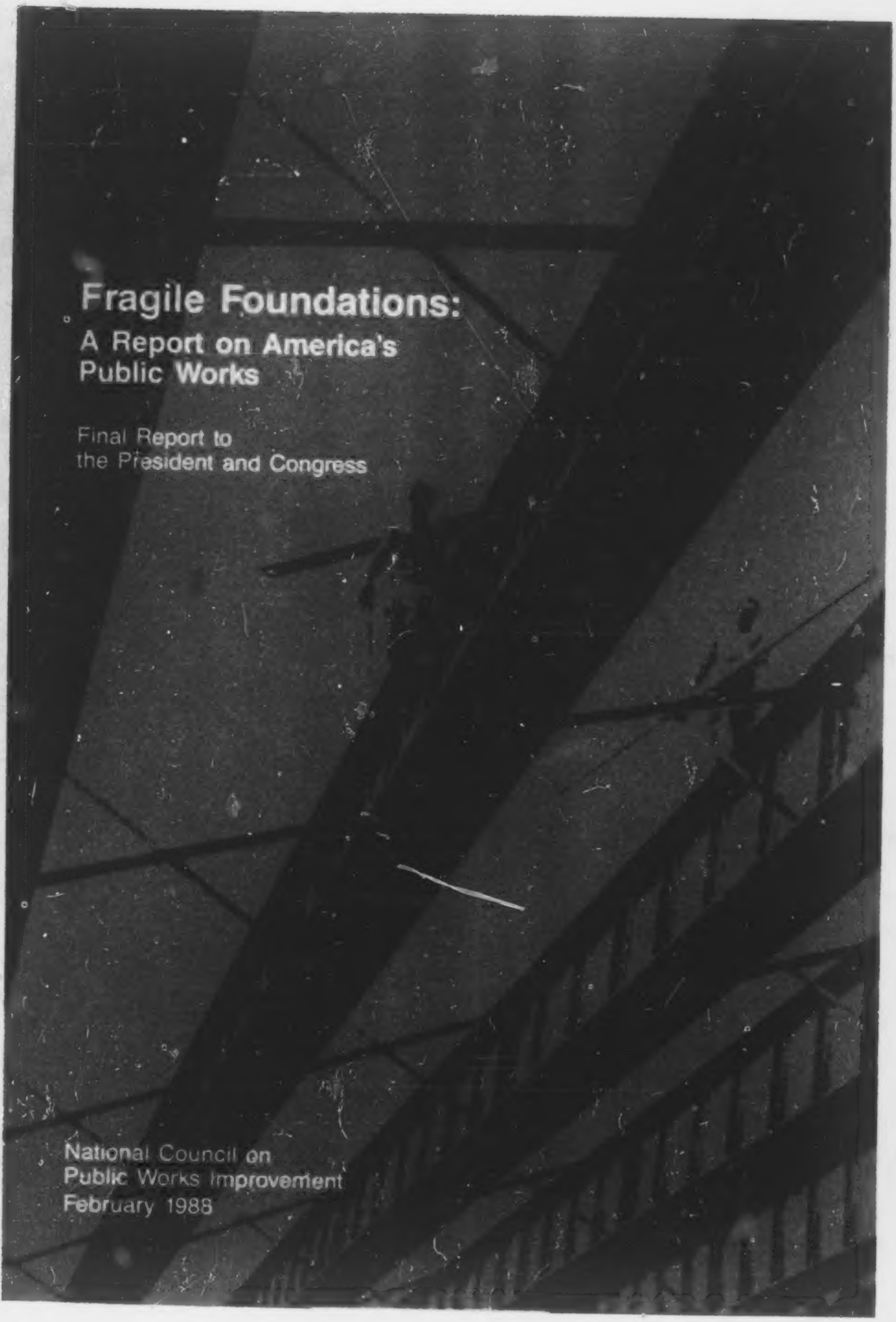

Fragile Foundations:
A Report on America's Public Works

Final Report to
the President and Congress

National Council on
Public Works Improvement
February 1988

FRAGILE FOUNDATIONS: A REPORT ON AMERICA'S PUBLIC WORKS

FINAL REPORT TO THE PRESIDENT AND THE CONGRESS

National Council on
Public Works Improvement
February 1988

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Nancy S. Rutledge

February 1988

Dear Mr. President and Members of Congress:

On behalf of the Council, it is my privilege to present the third and final report of the National Council on Public Works Improvement. This report completes our assignment in accordance with the Public Works Improvement Act of 1984 (P.L. 98-501).

In the past two years, the Council has conducted a thorough investigation of the state of America's infrastructure. This effort has involved thousands of public and private sector leaders and public works experts and practitioners throughout the country.

The final report presents the Council's conclusions and strategies for improving public works as a vital component of the nation's economy. The report also contains a complete summary of our research findings.

The Council is grateful for this opportunity to serve the nation.

Sincerely,

Joseph M. Giglio

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PREFACE

The National Council on Public Works Improvement (the "Council") was created by the Public Works Improvement Act of 1984 (P.L. 98-501) to assess the state of America's infrastructure. The results of that evaluation are presented in a three-part document, *Fragile Foundations: A Report on America's Public Works.*

- Part One summarizes the Council's findings and its conclusions about the capacity of the nation's infrastructure to support future economic growth. It also outlines the Council's proposed strategy for strengthening these facilities and restoring a clear commitment to the future.
- Part Two provides a synthesis of major themes from over 5,000 pages of research material prepared for the Council during the past two years. All of the research findings were reviewed and commented on by a wide range of public works experts in dozens of working group meetings, public hearings, and other public forums.
- Part Three contains an Appendix that analyzes the performance of eight major categories of public work and provides additional supporting information.

This report is the Council's final submission to the President and the Congress. Its first report, *The Nation's Public Works: Defining the Issues,* provided an overview of current knowledge and set a broad context for further discussion and research. The issues included public works needs, economics and finance, government roles, management and decision making, and technological innovation. That report was submitted to the President and the Congress in September 1986.

The second report took the form of a series of study papers commissioned by the Council from independent consultants on nine categories of public works facilities and services: highways, streets, roads, and bridges; airports and airways; mass transit; intermodal transportation; water resources; water supply; wastewater management; solid waste; and hazardous waste. Each paper addressed the main issues identified by the Council in its first report. In the final chapter of each paper, the consultants provided the Council with their own views on major policy options in that category. These recommendations were reviewed by the Council but were not necessarily incorporated into the Council's final policy conclusions. The entire series was transmitted to the President and the Congress in May 1987.

The Council also commissioned several analyses of cross-cutting themes that emerged from earlier work. These included: the role of dedicated revenues and special districts in funding public works; the unique problems of small public works systems; the link between infrastructure and economic activity; how other nations view infrastructure in their economic development efforts; the adequacy of the nation's public works; and improving the performance of public works through better management and decision making.

The Council has found much that is good about what cities, counties, special districts, states, and the nation are doing in planning, building, operating, and maintaining America's infrastructure. But on balance, the Council concludes that our infrastructure is inadequate to sustain a stable and growing economy. As a nation, we need to renew our commitment to the future and make significant investments of our own to add to those of past generations.

The Council and its staff are proud to report that the Council completed its work within its budget allocation and by the deadline established by the Congress.

ACKNOWLEDGEMENTS

The National Council on Public Works Improvement offers its sincere thanks to the hundreds of individuals and organizations that provided consulting expertise, information, and critical comment throughout the past two years. A special thanks goes to those who gave generously of their time and talents to participate in the more than 50 working group meetings and hearings sponsored by the Council over the last two years. This help came with considerable grace and enthusiasm despite tight deadlines and difficult assignments.

The members and respective staffs of the Advisory Group deserve special recognition for their invaluable assistance in reviewing countless documents and arranging Council hearings and other public forums. In particular, the Council would like to commend Secretary John O. Marsh and the Department of the Army in chairing the Advisory Group and providing essential leadership and support.

The Advisory Commission on Intergovernmental Relations provided the Council with expert advice and a strong administrative foundation throughout the Council's life. That assistance was invaluable in meeting its rigorous schedule.

The Council would like to make particular note of the contribution made by Richard Mudge and Kenneth Rubin of Apogee Research, Inc. In addition to performing specific research tasks, they both served as close advisors to the Council.

The Council also appreciates the support of President Bernard W. Harleston and the City College of New York for making the services of Distinguished Professor Milton Pikarsky available to the Council for the last two years.

FRAGILE FOUNDATIONS: A REPORT ON AMERICA'S PUBLIC WORKS

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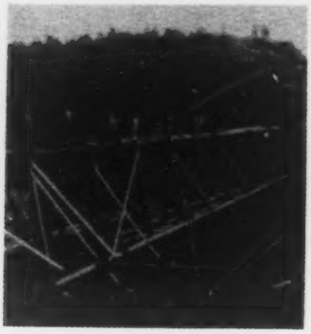
Summary of Findings

The quality of a nation's infrastructure is a critical index of its economic vitality. Reliable transportation, clean water, and safe disposal of wastes are basic elements of civilized society and a productive economy. Their absence or failure introduces an intolerable dimension of risk and hardship to everyday life, and a major obstacle to growth and competitiveness.



The Erie Canal; the transcontinental railroads; the great dams and water systems of the west; the airports, seaports, and transit systems that serve our cities; our network of modern highways and soaring bridges—all these are part of this country's great public works inheritance from the generations of Americans who built before us. These massive and sometimes daring achievements supported the growth of the greatest economic power the world has ever known. They have been the envy of other countries and the model for our competitors.

Now that inheritance is in danger.

After two years of study, the National Council on Public Works Improvement (the "Council") has found convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements, and insufficient to meet the demands of future economic growth and development.

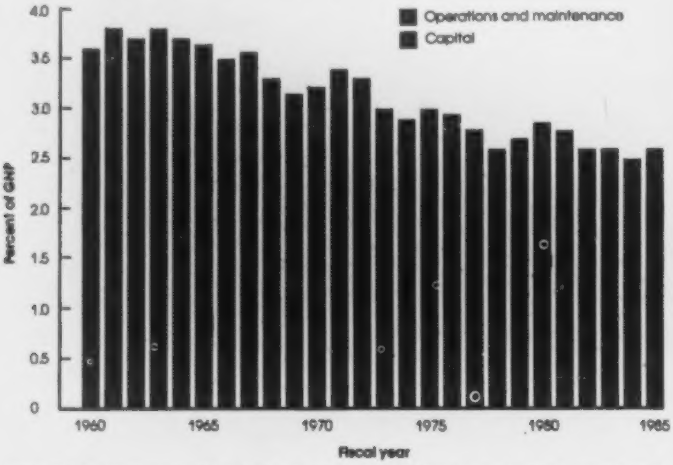
And unless we dramatically enhance the capacity and performance of the nation's public works, our own generation will forfeit its place in the American tradition of commitment to the future. Without such an effort, our legacy will be modest at best. At worst, we will default on our obligation to the future, and succeeding generations will have to compensate for our failures.

> *"We're spending our inheritance. You know, we built this freeway system . . . in the '50's and '60's, and we are still trying to make that do for today's needs."*
>
> Secretary Dewey Lonsberry,
> New Mexico Dept. of Highways
> and Transportation
> Council Hearing,
> Los Angeles, July 29, 1987

At present, most major categories of public works in the United States are performing at only passable levels. A few, such as water supply and water resources, remain in reasonably good shape. But others, such as solid waste and hazardous waste disposal, have serious and growing problems. In addition, smaller systems—in all categories and in nearly all regions of the country—face especially acute difficulties.

Part of the problem is financial. Overall investment in public works has slowed in the last two decades in relation to the demands of growth and environmental concerns. We have worn through the cushion of excess capacity built into earlier investments. In effect, we now are drawing down past investments without making commensurate investments of our own. Fig-

Figure 1—Public works outlays as a percent of GNP



Sources: U.S. Office of Management and Budget, *Budget Appendices of the United States*; U.S. Department of Commerce, Bureau of the Census, *Government Expenditure Series*; and *The Economic Report of the President*; for various years.

ure 1 illustrates this pattern of decline in public works spending as a percent of GNP.

With nearly one trillion dollars of public works assets[1] in the United States, reduced spending over the short term does not mean that individual facilities are in imminent danger of collapse, or that particular regions are in immediate peril. However, a declining infrastructure inevitably will jeopardize the productivity of our economy and our quality of life. Failure to reverse this decline will exact a high price for the nation in the future, both in the cost of deferred investment and in reduced economic competitiveness.

Therefore, the Council recommends a national commitment, shared by all levels of government, the private sector, and the public, to vastly improve America's infrastructure. Such a commitment could require an increase of up to 100 percent in the amount of capital the nation invests each year in new and existing public works. In 1985, this amount was approximately $45 billion.

Dramatically expanding current capacity or doubling the rate of capital spending is not an absolute requirement in all infrastructure categories, at all levels of government, or in all regions of the country. However, an increase in capital spending of this magnitude is an important and achievable goal for the nation as a whole by the end of this century. For some categories, such as hazardous waste disposal, an even greater effort may be warranted.

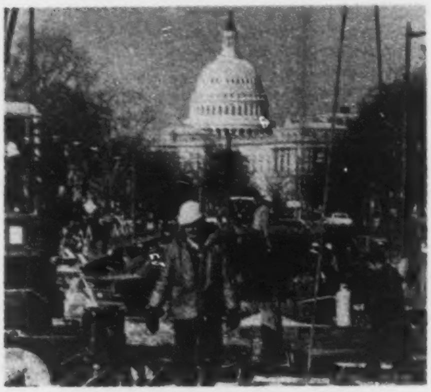
---

[1] This represents the approximate cumulative depreciated value of the public works facilities in the Council's purview. These include: highways, mass transit, aviation, water resources, water supply, and wastewater, solid waste and hazardous waste disposal. Public works can be interpreted more broadly to include communications, energy facilities, schools, hospitals, prisons, and parks. In an effort to target its resources, the Council has limited its primary focus to transportation, water, and waste disposal issues. Nevertheless, a considerable portion of its research findings and policy conclusions may apply to other areas.

A strategy to upgrade America's infrastructure must incorporate other tactics in addition to increased investment. **Thus the Council also recommends:**

- **Clarification of the respective roles of the federal, state and local governments in the construction and management of infrastructure to focus responsibility and increase accountability;**
- **Steps to improve the performance and efficiency of existing facilities;**
- **A rational capital budgeting process at all levels of government;**
- **Strong incentives to ensure adequate maintenance and, where appropriate, adopt new technologies; and**
- **More rigorous and widespread use of low capital techniques for delivering services and meeting service needs, such as demand management, coordinated land-use planning, and waste reduction and recycling.**

Through these measures the nation can make the best use of existing assets. This approach also may help to defer or avoid a significant portion of capital needs and costs that otherwise would be required in the future.

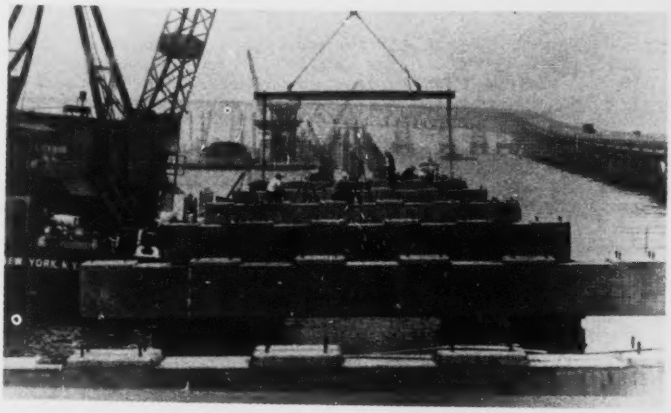


> *"Where in this myriad of problems is the good news? I would suggest that it lies in the opportunity to get government moving before an infrastructure crisis is upon us."*
>
> Michael Deland,
> Regional Administrator, EPA,
> Boston, Massachusetts
> Council Hearing,
> Boston, Aug. 3, 1987

The Council recommends that state and local governments continue to play their traditional leadership roles in the construction and management of the nation's infrastructure. But the Council also believes that the federal government must act as a full and responsible partner on a long-term basis in the national effort to increase and sustain public capital investment.

There is much to set right in America's house. The Council recognizes that an increased investment in infrastructure is just one among many critical claims on the nation's resources. To address this claim and others requires that we reckon first with the growing imbalance between consumption on the one hand and investment and savings on the other. This imbalance, reflected in the federal budget deficit and in other forms of borrowing against the future, affects all federal spending decisions. **The Council supports appropriate actions to redress the imbalance between consumption and savings so that future infrastructure commitments will not be shortchanged.**

The Council believes that infrastructure must rank high among our priorities. We must ensure that our highways and subways can move us swiftly and safely; that our homes, farms, and industries are supplied with ample clean water; that we re-



duce and safely dispose of the increasing volume of poisonous wastes our society generates; and that we provide the structural underpinning for a robust and competitive economy.

To reach this goal by the turn of the century, we must start now to rebuild what we have neglected, to repay where we have borrowed, and to invest again in our future and our children's future.

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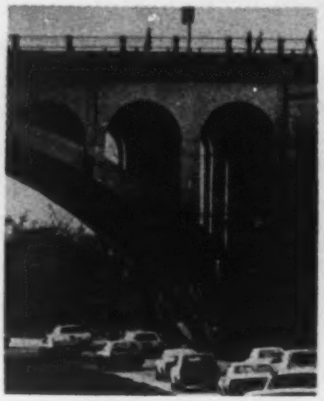
Reinvesting in America

Sharply upgrading America's infrastructure is an ambitious goal. It cannot be achieved in a short period. Our infrastructure problems are manageable, but only if we begin to mobilize our resources now. These problems cannot and should not be solved through a crash program. Rather, success requires that all levels of government and the private sector dedicate themselves to a sustained effort.

This effort should focus on the effective capacity of our infrastructure systems—the level and quality of public services provided by each category. No single approach by itself will be adequate. More money alone will not suffice. More effective management alone will not get the job done. Technology will not save the day. The complexity of these systems and their attendant problems demand a broad-based strategy.



> *". . . there is no 'quick-fix' for the problem. It's much more likely to be solved—eventually—through deliberate remedial steps rather than through a fast, dramatic 'conversion' of practices and attitudes."*
>
> Mayor George Latimer,
> City of Saint Paul, Minnesota
> Letter to the Council,
> June 22, 1987

Rating America's Infrastructure Performance

To determine where we must go, we first must assess where we are. The current condition of the nation's infrastructure is hardly encouraging. If our public works were graded on an academic scale, their recent performance would earn a scant "C"—barely adequate to support current demands.

Yet a single grade cannot reflect the variability of performance by category or within categories. For example, municipal refuse is collected with some success, but limited landfill capacity is making disposal more expensive and less effective.

The report card on the following page provides an overview of the performance of eight categories of public works. By identifying recent program changes and outstanding policy concerns, it also highlights opportunities for improvement.

> *"The public needs to understand that major public works projects have a tremendous lead time, especially if they are located in a metropolitan area or involve controversy. It took more than 20 years from inception to the opening of Interstate 66 from the Capitol Beltway to the city of Washington, D.C."*
>
> Albert A. Grant, P.E., President,
> American Society of Civil Engineers

REPORT CARD ON THE NATION'S PUBLIC WORKS

Subject Category	Grade	Successes/ Recent Changes	Problems/ Future Weaknesses
HIGHWAYS	C+	Federal and state gas tax increases have injected new capital into the system. This, along with inceased O&M spending, has improved pavement conditions. However, quality of service in terms of congestion is declining.	Spending for system expansion has fallen short of need in high-growth urban and suburban areas. Many roadways and bridges are aging and require major work. Needs of most rural and smaller systems exceed available resources. Highway Trust Fund has a sizeable cash balance.
MASS TRANSIT	C–	Federal capital grants have helped improve quality of service in some areas, but overall productivity of the system has declined significantly. Growth of transit vehicles is double the rate of increase in ridership. Diverting people from cars is increasingly difficult.	Mass transit is overcapitalized in many smaller cities and inadequate in large, older cities. Systems rarely are linked to land-use planning and broader transportation goals. Maintenance has been erratic and inadequate, especially in older cities.
AVIATION	B–	In general, the aviation system has handled rapid increases in demand safely and effectively. However, service has begun to decline in the face of increasing airport and airspace congestion as a result of strong traffic growth. The air traffic control system is currently undergoing a $16 billion modernization.	Congestion is the system's primary problem. Despite recent increases in authorizations, sizeable cash balance remains unspent in the Airport and Airway Trust Fund. The air traffic control system needs substantial upgrading to maintain safety.
WATER RESOURCES	B	Water Resources Act of 1986 made cost-sharing mandatory for many types of water projects. This change should improve project selection and reduce overall project costs.	Cost-sharing will improve efficiency but also increase local costs of water projects. Poorer communities may find it difficult to finance projects. Implementation is often excessively slow and cumbersome.
WATER SUPPLY	B–	While regional performance varies, water supply stands out as an effective, locally-operated program. Strict new standards created by the 1986 Safe Drinking Water Act will require drastic increases in water rates over the next decade.	Many public water systems suffer from pricing below costs, inability to meet purity standards, or source contamination. Storage and distribution systems are deteriorating in some older cities and supplies are limited in some parts of the West and several cities along the East coast.
WASTEWATER	C	Over 75% of U.S. population is served by secondary treatment plants. Shift from federal grants to state revolving loans may improve efficiency of plant construction. Broadened focus on nonpoint source pollution and groundwater contamination may accelerate progress toward cleaner water.	Despite $44 billion federal investment in sewage treatment since 1972, water quality has not improved significantly. This is due in part to uncontrolled sources of pollution, such as run-off from farmland and roadways. Overall productivity of secondary treatment facilities is declining, resulting in an increase in water quality violations.
SOLID WASTE	C–	Testing and monitoring of solid waste facilities are more rigorous as a result of tougher environmental standards. Waste-to-energy technology is growing as alternative to landfills. More aggressive waste reduction, separation, and recycling efforts are beginning at the local level. However, few states have moved boldly on these measures.	Nation faces significant costs of adequate and safe facilities. Limited data suggest trends toward fewer but safer landfills, rapid growth in resource recovery, and little progress toward waste reduction. Public opposition to siting all types of facilities is a major problem.
HAZARDOUS WASTE	D	Funding for site clean-up has increased five-fold since 1986, but progress has been slower than expected. Only a small fraction of the two tons of waste per capita produced in America each year is being treated safely. Major challenge is still ahead of us.	Nation has forfeited much of its opportunity to reduce waste before it is produced. Waste control legislation promotes "end-of-pipe" rather than source reduction solutions. Congressional mandates and schedules may be overly optimistic, given administrative resources. A massive backlog of poisons and needed cleanup projects faces the nation.

Current Spending on Public Works[2]

Capital investment represents front-end, long-term resources committed to the plant and rolling stock that provide public works services. Measured in 1984 dollars, state and local capital investment peaked in 1972 at $34 billion; annual federal outlays for capital, however, peaked at $25 billion in the late 1970s. This trend is charted in Figure 2.

Spending for operations and maintenance (O&M) is key to the overall longevity and efficiency of public works capital assets. In the aggregate, spending for O&M has continued to grow at a rapid rate since the 1960s (from $21.6 billion in 1960 to $56.5

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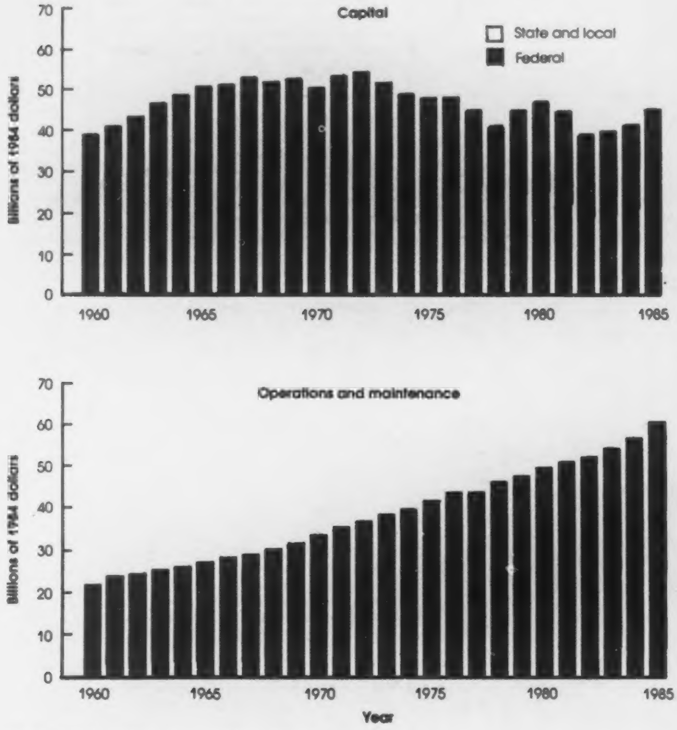
[2] All dollars are expressed in constant 1984 dollars, unless otherwise noted in the text.

Figure 2—Government outlays for public works



Source: Apogee Research, Inc., Government expenditure databases.

billion in 1984), as also shown in Figure 2. Underlying this trend was a small decline in federal operating outlays since the mid-1970s and a substantial increase in local O&M outlays over the entire 24-year period.

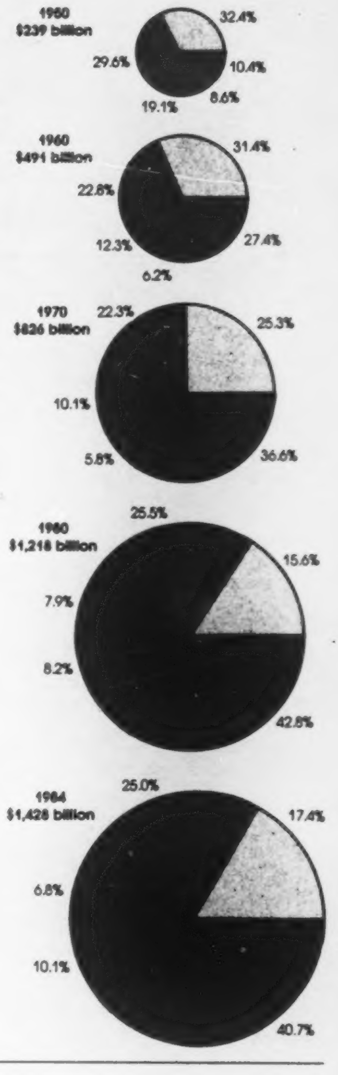
Public works spending patterns are of particular concern when viewed in relation to other measures of economic activity. For example, total public spending on infrastructure has dropped from 3.6 percent of the gross national product (GNP) in 1960 to 2.6 percent in 1985. While spending on operations and maintenance has remained a constant share of GNP, capital spending has dropped from 2.3 percent of GNP in 1960 to 1.1 percent today. The relative share of public works spending at all levels of government has declined drastically from nearly 20 percent of total expenditures in 1950 to less than 7 percent in 1984, as shown in Figure 3. During this same period, government spending for welfare and education increased from 10 percent to over 40 percent of total expenditures.

> *"There is . . . growing concern at the state and local level that . . . given competing demands for funding at the local level for education, health, welfare and public safety programs, the public works infrastructure may indeed experience severe deterioration in the coming years."*
>
> Harout Sanasarian, Supervisor
> Milwaukee County, Wisconsin
> Council Hearing,
> Indianapolis, July 12, 1987

Figure 3—All government spending, 1950–1984 in 1984 dollars

1950	$239 billion
1960	$491 billion
1970	$826 billion
1980	$1,218 billion
1984	$1,428 billion

- ▨ Defense
- ☐ Nondefense discretionary
- ■ Public works
- ■ Interest on general debt
- ■ Public welfare/education



Source: Apogee Research, Inc.

Public works investment is growing more slowly than private capital investment. Private-sector capital investment increased by about 51 percent between 1975 and 1985, but public works investment fell by more than 6 percent over the same period. Figure 4 shows the decline in public works spending per dollar of new private capital put in place.

Economic Prognosis

What do these trends mean for the health of the economy? The level of public works spending is only one indicator of the quantity and quality of service. However, we do know that public investment generally increases the productivity of private investment. Thus the growing imbalance between public and private investment means that we probably are not getting as much value as we could for every private investment dollar. The resulting loss in productivity limits the growth of the economy and our ability to compete in world markets.

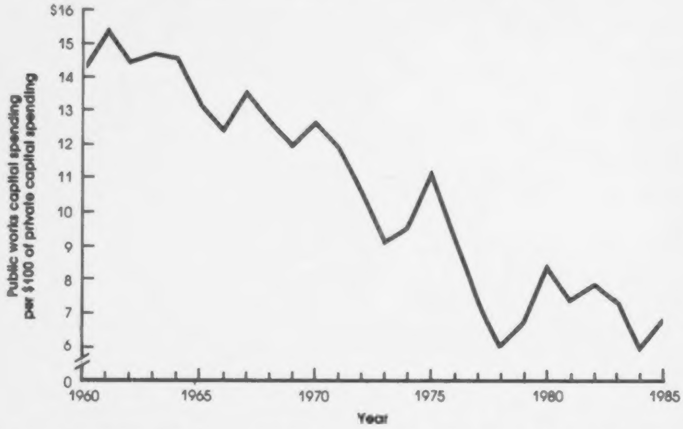
In light of these spending trends and the concerns about future performance outlined above, it is clear that substantially more must be done—and we must start soon.

> *"For the sake of our nation's future, we must provide the funds necessary to maintain and improve roadways and bridges. These are the networks essential for our economic survival."*
>
> James Sullivan, President,
> Greater Boston Chamber of Commerce
> Council Hearing,
> Boston, Aug. 3, 1987

Elected officials and the public at large must recognize that capital expenditures are not the only cost of public works; rather, the expense incurred through delays in providing needed services, added to the value of lost economic opportunities, often can exceed direct budget costs.

> *"The long pattern of disinvestment and a deteriorating infrastructure have eroded our capacities to sustain economic growth—growth which is translated directly into jobs for Americans."*
>
> The late
> Mayor Harold Washington
> City of Chicago
> Council Hearing,
> Chicago, Sept. 30, 1987

Figure 4—Comparison of public works capital spending to private capital spending



Sources: National Council on Public Works Improvement calculations based on the *Economic Report of the President*, January 1987, Appendix B, and Apogee Research, Inc., Government expenditures database.

Our current level of capital investment is barely enough to offset annual depreciation, much less meet new demands. The U.S. Department of Commerce estimates that infrastructure use by industry alone will increase by at least 30 percent over the next ten years as a result of economic growth, the dispersion of population and economic activity, and technological and structural changes. Infrastructure capacity must keep pace with this increase while still maintaining the current quality of service. Better service—reduced congestion, improved water quality, higher safety levels—will require even greater capacity expansion, as well as extensive operational improvements.

"The condition of our transportation infrastructure is a critical factor in determining our nation's productivity and our ability to compete and survive in today's world market. We face widespread economic decline if we allow our tremendous highway infrastructure investment to deteriorate."

Commissioner Leonard Levine,
Minnesota Department of Transportation
Council Hearing,
Chicago, Sept. 30, 1987

"Currently the cost of congestion in Los Angeles County is about 485,000 hours per day of wasted time by our residents or people driving through the county. That converts . . . by our estimates to a minimum of about $507 million per year in wasted time, and about 72 million gallons of gasoline . . . just in our county."

Rich Richmond, Executive Director,
Los Angeles County
Transportation Commission
Council Hearing,
Los Angeles, July 29, 1987

While a sound infrastructure does not guarantee future prosperity, long-term economic growth cannot be achieved without it. Economic efficiency and public health both are linked inextricably to adequate transportation, water quality, and waste disposal services. In addition, infrastructure investment directly supports additional economic activity. For every public dollar spent on an annual basis to build and maintain our network of roads, streets, and bridges, the private sector spends $15 to move people and goods. For every public aviation dollar, private firms and individuals spend nine.

If we spend too little on public works or if we invest in inefficient projects, society loses more than the direct public cost. In the long run, our ability to compete in the international economy will be weakened, and our standard of living will suffer.

Finding the Money

Much of the discussion about public works in recent years has focused on choosing appropriate finance mechanisms—e.g., revolving loan funds, intergovernmental grants, tax-exempt debt techniques, or various forms of privatization. While these options may differ in terms of the attractions they offer to public officials, they all draw on two basic sources of funds—*general tax revenues* and *user fees*.

Mobilizing adequate financing to meet our current and future public works needs requires participation by all levels of government. **The Council endorses the following principles to guide this effort:**

- **Users and other beneficiaries should pay a greater share of the cost of infrastructure service.**
- **The federal government should be a reliable partner in financing public works.**
- **States should develop comprehensive infrastructure finance strategies.**
- **Local governments should give budgetary priority to funding the maintenance of existing facilities.**

Emphasis on the Beneficiaries

Today almost 75 percent of public capital spending on infrastructure is derived from users. Yet only about 50 percent of spending on operations and maintenance comes from this source. Significant elements of transportation, water supply, wastewater treatment, and solid and hazardous waste systems serve identifiable consumers on a continuing basis. Use can be measured and priced; those who do not pay can be excluded from services. Linking financing to use can produce a steady and predictable revenue stream, encouraging better maintenance, rehabilitation, and replacement.

> *"New strategies like public-private partnerships will help. So will federal initiatives. . . . But what I think is really needed first is a national consensus. We need to better define the scope of the problem—what are the specific needs for all levels—and then identify what resources can be marshalled and by whom."*
>
> Mayor Don Erickson
> Cheyenne, Wyoming
> Council Hearing,
> Los Angeles, July 29, 1987

The Council recognizes important limitations to the user fee principle. Many smaller communities lack the financial base necessary to finance a facility—especially when new capital investment is required. Fees for certain types of essential services, such as water supply, sewage treatment, and solid waste disposal, also can be excessively expensive for lower income residents or hard-to-serve areas.

Options to address these problems may include guarantees or insurance for small-issue debt; state bond banks that combine small bond issues into larger, more creditworthy statewide issues; selected increases in grants targeted to smaller facilities or those serving lower income areas; and regionalization of services to achieve economies of scale. Providing a threshold level of service and a safety net in these instances also may require general revenues to supplement user fees.

Public works produce both direct and indirect benefits. For example, a mass transit system benefits the transit riders as well as the motorists who travel in the area. In addition, mass transit often benefits business and commercial interests. Thus, the cost of transit development or expansion should be borne by all three groups.

> *Twenty years ago developers looked almost entirely to the public sector for infrastructure. Today with increasing population and migration of people and businesses to the cities and surrounding counties of Nashville growing so much faster, the public sector can no longer provide total infrastructure needs. The future must be a joint effort.*
>
> George Volkert, President
> Southland Venture Company,
> Nashville, Tenn.
> Council Hearing, Nashville, June 9, 1986

User fees may prove inadequate for major new investments in infrastructure technology and economic development. Such projects have few immediate or easily identifiable beneficiaries. Instead, they represent long-term commitments to the future, and rightfully are a matter of common responsibility, to be financed out of general funds or a user fee base that includes both present and future beneficiaries.

The Council endorses the general principle that developers should pay an equitable portion of the cost of new facilities necessary to service commercial, industrial, and residential development. State and local officials should exercise due care to see that the allocation of such costs is fair and reasonable and does not result in undue private influence over public development policies and priorities. Further, it should be recognized that developer fees and exactions will have an impact on the cost and availabilty of housing.

The Council urges that federal user fees paid in good faith by beneficiaries to preserve and protect public works systems be spent for that purpose. The accumulation of unspent balances in the federal highway, transit, aviation, and waterways trust funds—nearly $24 billion in the 1987 budget—is at odds with this principle. **The Council supports a determined, incremental effort to reduce these balances—in line with responsible management and planning—so that the funds can be used for necessary infrastructure improvements.**

Federal Partnership

Between 1960 and 1975, federal grants-in-aid as a portion of total state and local capital spending remained relatively stable at about 33 percent (Figure 5). In the late 1970s, federal aid rose to more than 50 percent; since then it has leveled off at 40 to 45 percent. These patterns reflect a decline in capital spending by state and local governments as well as shifts in federal grant policy.

In the realm of infrastructure finance, the federal government traditionally has focused on providing public works capital. Because of its limited involvement in maintenance and operations, the federal government accounts for less than 30 percent of all public works spending.

The Council urges the President and the Congress to recognize the importance of maintaining a continuing federal role in infrastructure finance. Intergovernmental aid still is necessary to launch major projects of national interest, or to help governments with limited fiscal capacity. However, some changes in the form of federal spending may be necessary to accommodate shifting federal, state, and local roles and relative fiscal capacities.

Whatever form federal assistance takes, it should offer state and local governments:

- Stability over several years to aid long-range planning;
- Flexibility in the use of funds through such mechanisms as block grants, and
- Incentives for increased efficiency and improved maintenance.

In addition, the federal government should exercise restraint in adopting legislation that would limit the revenue-raising capacities of state and local governments.

Federal tax policy also has a significant impact on infrastructure finance. For example, the Tax Reform Act of 1986 drastically limits arbitrage earnings on borrowed funds and restricts the use of municipal bond proceeds for quasi-public projects by imposing ceilings on allowable issues. These and other provisions are expected to limit the growth of tax-exempt bonds, and to increase state and local borrowing costs. The law also lengthens depreciation schedules and repeals investment tax credits, which will increase the cost of joint development of certain public works with the private sector. In combination, the provisions of the 1986 law may impede the financial plans of state and local governments, reduce their fiscal capacity, and limit their ability to finance necessary improvements.

The Council urges the President and the Congress to pay close attention to the effects of tax reform, and to remove unwarranted limitations on the power of state and local governments to finance public works.

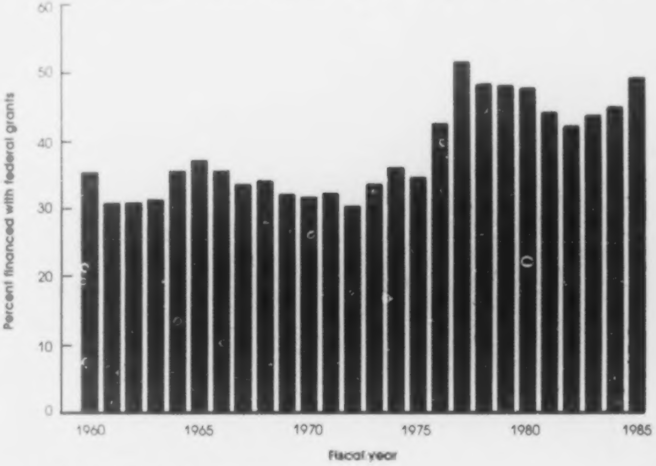
State Strategies

Although a number of states have instituted innovative financing programs, the state share of overall spending on infrastructure dropped from 32 percent in 1970 to 23 percent in 1985. At $25 billion annually, state

"I think we have seen the end of . . . massive amounts of federal dollars returning to local governments through federal revenue sharing and any grant program. I think at the state and local levels we must . . . go to Washington and ask for programs and policies that are feasible in light of the changed fiscal circumstances."

Ronald Bean, Executive Director,
Illinois Development Finance Authority
Council Hearing,
Chicago, Sept. 30, 1987

Figure 5—Percent of state and local public works capital spending financed with federal grants



Source: Apogee Research, Inc. Government expenditures database

taxes and fees now finance less than one-third of expenditures on state and local public works programs.

While localities are under pressure to fund an increasing portion of total public works spending, often they must contend with state restrictions on taxation or bonding. For example, as of 1985, 31 states had imposed specific property tax rate limits on local governments. Six states had either constitutional or statutory limits on the total amount of revenues that local governments could collect annually.

The Council encourages governors and state legislatures to examine the impact of such restrictions on state and local public works. Where state constitutional or statutory limitations hinder the ability of the state and local jurisdictions to deliver essential services or adversely affect their credit ratings and finance capacity, states should assume responsibility for either remedying the situation or providing compensatory assistance.

Future Finance Options

The Council has called for a substantial increase in the capacity and effectiveness of the nation's public works. This goal is not attainable unless we first make better use of existing financial resources. In most cases, however, we cannot rely simply on wiser spending; we also must generate additional sources of funding. This burden will fall on all levels of government and involve virtually every category of public works.

The Council supports the concept that the unit of government responsible for service delivery should be the one that levies the fees or taxes to the extent possible and practical.

> *"We as local communities are property tax dependent. We have no access . . . and it is true in most all New England states, to any other forms of taxation."*
>
> Pam Plumb, City Council Member, Portland, Maine, and 1988 President of the National League of Cities
> Council Hearing,
> Boston, Aug. 4, 1987

This will strengthen accountability for the cost and quality of public works service. Local governments already bear the lion's share of operating and maintenance costs and a growing portion of capital costs as well. But to carry out their responsibilities, they must have the proper tools, such as taxing and bonding authority and access to the tax-exempt municipal bond market.

> *"One point seems to be very clear. The people are willing to dig into their own pockets to pay for better roads, more schools, clean water, expanded airports, improved transportation, and the items which help shape the quality of life in the Golden State."*
>
> Don McGrew, President,
> Griffith Company,
> Long Beach, California
> Council Hearing,
> Los Angeles, July 29, 1987

It is not appropriate for the Council to propose a specific legislative program of new fees and taxes to finance public works improvements. The most equitable and efficient mechanisms will depend on the type of infrastructure problem being addressed and on local conditions, traditions, and institutions. These trade-offs are made through the political process at all levels of government. The menu of possible revenue sources listed in Table 1 provides a starting point for assembling such a program.

Many of the options in Table 1 represent simple expansions of existing user fees or related excise taxes. The largest potential sources of funding are motor fuel taxes used by the federal and state governments to support highways and some transit spending, and developer exactions and related fees imposed by many local governments. Local exactions are perhaps the fastest growing means of infrastructure finance, as well as the least well known.

Table 1.—Possible Sources of New Public Works Revenues

Source	Level of Government	Current Rate	Possible Increment	Potential Revenues ($ millions/year)
Motor Fuels Tax				
a) Flat Tax	F.S.L.	$0.23/gal[a]	$0.10/gal	$12,000
b) Ad Valorem	F.S.L.	([b])	10% of fuel costs	9,500
Repeal Exemptions from Highway Taxes	F	([c])	N.A.	1,000
Heavy Truck Taxes	F.S.			1,000
Aviation Ticket Tax	F	8% of value	2% of value	800
Airport Service Charge	L	None[d]	$3/passenger	1,500
Inland Barge Fuel	F	$0.10/gal[e]	$0.10/gal	50
Port Tax	F	0.04% of cargo value	0.06% of cargo value	250
Cash Balances in Trust Fund Cash	F	N.A.	([f])	2,000
Water Supply	F.S.	None[g]	$0.10/1,000 gallons	750
Waste-End Taxes	F.S.			
a) Generation		None	$5/ton	1,500
b) Disposal —by Hazard		None	$0–$60/ton	2,600
c) Disposal —by Method		None	$4–$25/ton	3,200
Local Impact Fees on Developers	L	([h])	([i])	10,000-15,000

NOTE: Revenue estimates show gross receipts and have not been adjusted for potential reductions in other taxes. These offsets could reduce gross receipts by as much as 25 percent.

SOURCE: Apogee Research.

[a] The current federal tax is 9 cents per gallon of gasoline. State taxes average 14 cents per gallon. The federal government taxes diesel fuel at an additional 6 cents per gallon.

[b] Some states currently collect sales taxes on motor fuel.

[c] State and local vehicles, transit buses and users of gasohol are exempt from certain federal and state taxes despite the wear and tear they cause on roads and bridges.

[d] This charge, commonly referred to as a "head tax," currently is prohibited by federal law.

[e] Scheduled to increase to 20 cents per gallon by 1995.

[f] Assumes the current trust fund cash balances will be used over the next ten years.

[g] None at the federal level; Washington is one of the few states with a water excise tax.

[h] Many local governments already impose some form of negotiated fee for the infrastructure costs resulting from new development.

[i] Assumes that impact fees and related techniques are increased to equal 20 to 30 percent of capital spending. Potential revenues are not likely to be realized until the mid-1990s.

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Sharpening Accountability for Infrastructure

Dependable, high-quality infrastructure is not the product of money alone; building and maintaining public works requires a shared vision, commitment of time and energy, and the skills of people throughout the public and private sectors. Historically, such consensus often has been a local or regional phenomenon in America. The result is a system that is highly decentralized and subject to continual change. Each community has its own laws, traditions, and other characteristics that govern the way it apportions responsibility and resources for public works.

On the whole, this system has worked well in providing public works facilities and services for a large number of communities. But too often, when problems arise, ultimate responsibility among various levels of government is not understood clearly by either the public or its leaders. When the solutions are costly, complex, and controversial, or involve a wide range of players, our tendency, as individual communities and as a nation, is to stall and point our fingers at the "other guy" until we reach a crisis. By this time we generally have foregone the most sensible and inexpensive options. Last summer's story of the Long Island garbage barge wandering forlornly around the Caribbean is one such example. Most of its cargo was used paper—a commodity that could have been recycled for sale in many parts of the world. In the end, accountability was fixed back on the community that generated the garbage, but by then the cargo was waterlogged and without value.

The Council urges that the roles of the federal, state, and local governments be clarified to help boost the performance of the nation's public works.

In general, the Council believes the federal government should continue its primary role in hazardous waste disposal and cleanup, air traffic control, inland waterways, highways of national significance, intermodal freight transportation, minimum performance standards for environmental protection, major capital investments for flood control and shoreline protection, and the overall coordination of water resource programs.

> *"There is no perfect solution to solid waste disposal. . . . Everything we do will have some minor impact. . . . It must be disposed of and that place is inevitably in somebody else's backyard, and that is one of our problems."*
>
> Frank Borchardt,
> Executive Vice President,
> HDR Techserv,
> Omaha, Nebraska
> Council Hearing,
> Chicago, Sept. 30, 1987

In turn, states should have lead responsibility for highways of statewide significance, non-federal dam safety, major capital financing of wastewater treatment, airport system planning, and the siting of waste disposal facilities.

Local governments, or in some cases regional authorities, should have primary responsibility for local streets and roads, public transit, individual airports, water supply systems, ports, urban stormwater, wastewater treatment facilities, and solid waste disposal. In many instances, these services may be financed and operated by private firms through agreements with local jurisdictions. Opportunities for private participation should be considered actively by all levels of government but should not be seen as a panacea.

The impact and importance of most public works are not neatly locked within the boundaries of any given jurisdiction. One community's failure to provide good roads or adequate sewage treatment may hinder all others in the vicinity. Stewardship of the infrastructure as a whole demands some degree of accountability by all levels of government. However, in a dynamic and fractionated federal system such as ours, accountability can be measured more usefully against general principles than rigid standards.

The Council believes that state and federal infrastructure policy should support local self-sufficiency to the greatest extent possible. This means that:

(1) **Federal and state statutes should be far clearer and more rigorous in specifying who is responsible for doing what, and by what deadline.** Many laws and program guidelines governing complex projects contribute to delay and lack of accountability by failing to set timely deadlines for reviews. Nor do they specify who will resolve conflicting advice or opinions when many different agencies are involved. The immense difficulties of siting solid and hazardous waste facilities and the long, costly delays associated with port and navigation projects are reflections of this bureaucratic equivocation;

(2) **Federal and state public works mandates should be considered carefully and allow cost-effective methods of compliance rather than rigid technical requirements.** For example, in older urban areas, "dial-a-ride" services can provide equivalent mobility for the physically handicapped more cost-effectively than retrofitting all transit vehicles;

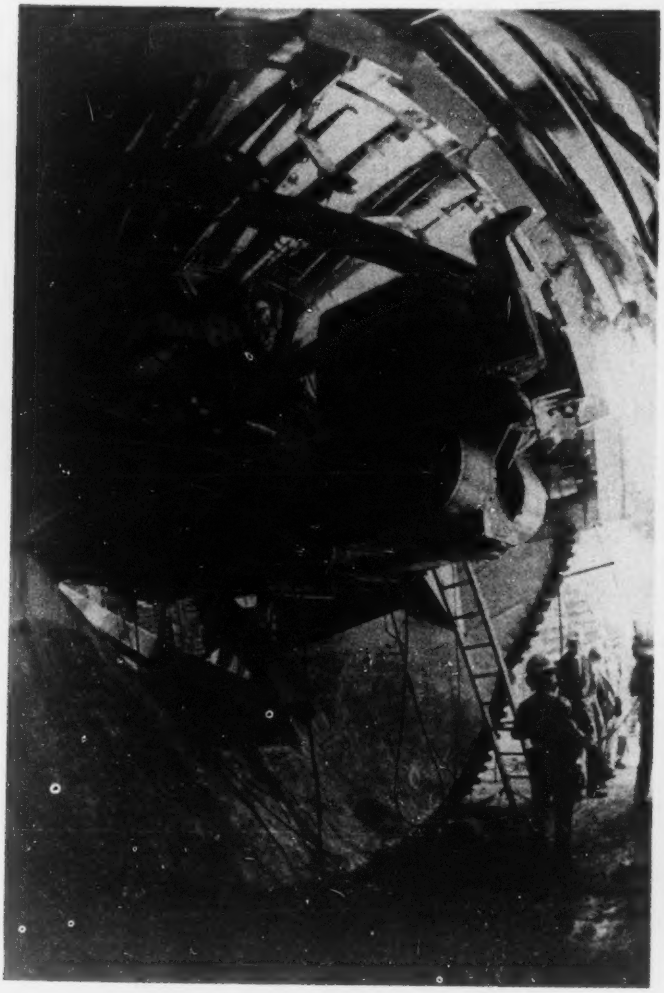
(3) **Rules governing state and federal programs should recognize the distinct financial and managerial needs of small and rural governments;**

(4) **States should seek to promote cooperation among local jurisdictions, as well as between state and local government.** State advisory councils on intergovernmental relations, regional planning commissions, councils of government, and interlocal agreements are useful mechanisms to achieve this goal; and

(5) **The federal and state governments should address the need for adequate technical information and expertise when they impose responsibilities on local government.** "Circuit riders" or other forms of technical assistance and training should be considered where appropriate.

"There is an urgent need for the assignment . . . of responsibility for the assurance of the integrity and safety of bridge structures. The current fragmentation among state agencies and separate authorities . . . fails to provide the level of public protection for which government is ultimately accountable."

David Axelrod, M.D., Chairman,
New York State Disaster
Preparedness Commission
Memorandum to Gov. Mario M. Cuomo
on the Schoharie Creek Thruway
Bridge Collapse Report,
Dec. 2, 1987



20

Strengthening System Performance

The principal value of public works lies in the services they deliver—e.g., reliable transportation, clean water, and safe disposal of wastes. Physical assets, such as pipes, bridges, and lane-miles of freeway, make these services possible, but they come with no guarantee that they will deliver the quality, quantity, or cost of service needed to sustain our economy and standard of living. The performance of these assets depends on a range of human and technical factors, as well as the ongoing level of capital investment and maintenance.

If, as the Council recommends, the public is asked to provide increased capital for current and future infrastructure capacity, governments at all levels have a corresponding responsibility to get the maximum value out of every dollar spent. In many cases, it may be possible and prudent to postpone some new investment by increasing efficiency through improved operations, employing more aggressive maintenance procedures, and adopting various demand management techniques (such as full-cost pricing, land-use policies, or waste reduction and recycling).

Public works design, construction, operation, and maintenance should be viewed as phases of a single process. New equipment or facilities can be designed and built for ease of operation and maintenance. Timely repairs reduce long-term operating costs and ensure the full life expectancy of existing facilities and equipment. Innovative operations sometimes can add capacity for little cost and reduce maintenance needs (e.g., computerized traffic control systems and non-corrosive snow and ice melting compounds).

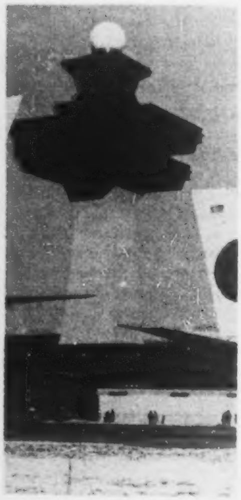
The Council encourages renewed attention at every level of government to maintaining our current assets to optimum standards. Maintenance is perhaps the single most important element of governments' stewardship obligation. It also is the element that is easiest to defer, and the one most likely to be cut from the current expense budget.

Maintenance must be made more visible. This means providing understandable information on infrastructure conditions, performance, maintenance costs, and the annual amounts of deferred maintenance.

> *"When highways and bridges are regularly maintained there is no press coverage. When they are rebuilt it is an 'event.' There is a ribbon-cutting and plenty of press coverage. The incentives, therefore, are for public officials to purposefully starve the maintenance budget. . . . Until this motivation . . . is acted upon, we will be treated to recurrent infrastructure crises. In fact, proposals for infrastructure bonds, banks, etc., only abet this whole process."*
>
> Edward V. Regan, State Comptroller,
> State of New York
> Letter to the Council, January 15, 1988

It means actively educating the public—as shareholders in the nation's capital stock—to the importance of the *long-term* integrity of the system. In fact, public education is an important element of any strategy to improve our nation's infrastructure.

> *"One of the problems with the streets is that as you delay, the cost escalates. . . . If you allow them to fail without maintenance, then you are tripling or quadrupling . . . the cost to repair a street versus just maintaining it."*
>
> Robert Horii, City Engineer
> Los Angeles Dept. of Public Works
> Council Hearing,
> Los Angeles, July 29, 1987



Other options that may help to lengthen the life of infrastructure systems include removing restrictions on federal and state grant funds to allow them to be used for improved operations and maintenance, and creating stronger maintenance incentives in revenue bond covenants.

The Council endorses a variety of operational improvements to increase current capacity and improve performance. For example, the primary problem with airport and airway facilities is congestion. However, new runways may not be the only answer; the solution at some airports may be to install available equipment that allows planes to depart and land safely at closer intervals. Demand management strategies, such as peak load landing fees, have reduced congestion at all three major airports serving the New York/New Jersey metropolitan area.

Demand for waste disposal facilities can be managed by waste reduction, separation, and recycling. Certain states have established goals of recycling anywhere from 15 to 40 percent of the waste stream. For example, ten states, including Oregon, Massachusetts, Maine, and Michigan, have implemented "bottle bills" to promote recycling and reduce waste. Massachusetts also is constructing a number of materials recovery facilities throughout the state.

Regulations governing product packaging can help reduce waste. Fees or surcharges on items that are difficult to dispose of (e.g., lead, zinc, or plastics) can reduce their use. Regulations requiring reuse of, or deposits on, recyclable items such as automotive batteries and motor oil serve the same purpose.

The Council strongly encourages all levels of government to upgrade the quality and quantity of basic public works management information in order to measure and improve system performance. At present, too many infrastructure investment decisions in America are made "by the seat of the pants." Small and medium-sized jurisdictions (and many large ones too) do not have complete inventories of existing facilities; most do not conduct regular surveys of the condition of public facilities or collect information on the quality, quantity, or cost of services. Only a handful of jurisdictions take advantage of established analytic techniques for computer mapping, life-cycle cost analysis, automated asset management, or precise tracking of growth trends.

While the up-front costs and paperwork required to set up data collection, management, and reporting systems can appear formidable, the absence of this information means that public officials must make multi-million dollar investment decisions on an *ad hoc* basis. The costs of estimating required capacity incorrectly or selecting a project ill-suited to needs can be staggering, particularly in the face of the fiscal and economic pressures facing most state and local governments.

In planning for public works investments, every jurisdiction should be guided by clearly stated performance objectives, consider alternative ways of achieving them, and have access to realistic information about costs of operation and maintenance. The capital budgeting process should

examine the entire range of public works needs to guarantee that the choices made reflect a rational set of priorities.

> *"Only with broad public understanding and support, especially as perceived by the responsible public officials, can any initiative or action involving political risk be successful."*
>
> Walter T. Olson, Program Director,
> Build-up Greater Cleveland
> Council Hearing, Chicago, Sept. 30, 1987

> *In Madison, Wisconsin, a $40,000 public education campaign convinced many residents to shift their water use away from the 6 p.m. peak. The relatively modest investment averted the construction of a new well system once thought necessary to meet peak demands. Savings to the community were at least $750,000 in new well construction, plus some $60,000 a year in operating costs.*

The private sector and a majority of state and local governments are setting the course and establishing proper standards for capital budgeting to meet generally accepted accounting principles (GAAP) and to gain a clearer picture of their capital needs and related financing requirements and resources.

The Council believes that the federal government should consider following their example. Capital budgeting at the federal level should seek to identify, define, and present separate operating and capital components of the federal budget while *maintaining a unified budget*. Direct federal spending on capital projects—such as roads and bridges, hospitals and housing, and military bases—and federal grants to state and local governments represent distinct forms of federal capital investment that may require different approaches. However, both can benefit from better planning and more consistent allocation procedures.

By requiring an annual analysis of federal capital spending, the Federal Capital Investment Program Information Act of 1984 (passed as Title II of P.L. 98-501 which established the Council) provided a constructive first step toward the development of an overall federal infrastructure strategy. **The Council urges the Congress and the President to institute capital planning and budgeting procedures as an integral element of the federal decision-making process. Such procedures would be the next logical step toward building a stronger fiscal—and physical—foundation for America.**

The City of Saint Paul offers one example of a far-reaching program designed to take advantage of computer technology and avert future crises. The first phase, Computerized Infrastructure Inventory, *was put in place in 1986, and provides a detailed data-base on the construction materials, location, age, and condition of all the city's public works facilities. The second phase,* Computerized Maintenance Management, *which began to be implemented this past summer, links inventory data to city maintenance schedules, requests for service, and maintenance results. The third phase,* Computerized Mapping, *will be installed in the next few years and is expected to provide a complete electronic map of all streets in Saint Paul. Public works managers will be able to "overlay" infrastructure information on this map in order to develop and analyze maintenance strategies.*

Accelerating Innovation

The strength of America's infrastructure systems directly reflects our capacity and commitment to renew and improve public works technologies and their applications. Such technologies range from sophisticated robotics for trenchless pipe-laying to the asphalt used to pave the streets. Their development, implementation, and maintenance depend on a combination of knowledge, materials, equipment, and skilled people. Innovative, up-to-date technologies can guarantee efficient, safe, effective service and contribute to economic growth. Outdated technologies may endanger public safety, increase the cost of service, and reduce the competitiveness of business and industry.

The Council finds that the level of effort and resources applied to infrastructure research and development (R&D) in the United States falls far short of current as well as future requirements. Federal spending on infrastructure R&D in 1985 was approximately $103 million, less than one third of one percent of total new infrastructure construction in that same year. This portion has been falling steadily in recent years, as has private sector spending on similar activities. The potential return on more research is enormous.

Such a decline in R&D is especially troubling in light of evidence that the nation is becoming more dependent on foreign producers in certain public works categories. For instance, not a single American-owned firm currently builds transit rail cars. U.S. imports of machinery exceeded exports by $15.8 billion, or 27 percent, in 1985. By comparison, only a decade ago, our machinery exports exceeded imports by 58 percent.

> *"We have lost a generation of talent in transportation . . . because we haven't been putting money to support R&D through universities."*
>
> Dr. Robert Paaswell, Executive Director,
> Chicago Transit Authority
> Council Hearing,
> Chicago, Sept. 30, 1987

Other developed countries give greater support to public works R&D and technical innovation. Most of our trading partners invest a larger share of GNP in infrastructure R&D than the U.S. In addition, Japan and many European governments support R&D through tax incentives or matching funds, as well as flexible bidding and contracting arrangements. Major Japanese construction firms, although they had less than two-thirds the contract volume of their American counterparts, spent ten times as much on R&D in 1985. A sustained investment of this magnitude is likely to produce an increasing number of "cutting-edge" technologies that will find their way into the American public works construction market.

With nearly a trillion dollars of infrastructure fixed assets already in place in the United States, small changes in the reliability or efficiency of key components can result in major cost savings. However, we also face emerging problems of immense technical complexity—such as groundwater contamination, hazardous waste disposal, and traffic and airport congestion—that demand much more than tinkering with current methods. Technology is not the total answer, but clearly it is an essential part of it.

"Science and technology are fundamental to U.S. competitiveness. America's preeminence in research and innovation has long been the envy of the world and a critical source of our national strength."

President Ronald Reagan
State of the Union Message,
1987

Currently, no federal agency or other organization has the primary responsibility for systematically focusing national R&D efforts on infrastructure problems. Current federal programs are spread over a number of agencies with narrowly targeted missions. Ongoing research efforts conducted by other levels of government, professional organizations, and the private sector are fragmented and aimed only at incremental improvements. The opportunities for major breakthroughs and for sharing research results among all groups often are very limited.

The Council concludes that the scope and complexity of infrastructure problems throughout the United States merit a far more intense national focus on public works technology. This focus should be comprehensive—encompassing all infrastructure categories. It should be cooperative—involving representatives of all levels of government, professional organizations, and the private sector. Finally, it should be coordinated—tying together and building upon current R&D efforts.

While federal leadership and a continuing national framework are necessary, this approach need not require a large new federal bureaucracy. The Council believes that the goal of accelerating public works innovation would be served best by regional centers responsive to the public works market and particular variations and requirements within their respective geographic areas. Such centers could be either university based or operated in conjunction with existing research institutions.

Models for this approach are readily available. The National Science Foundation recently established specialized Engineering Research Centers at a number of universities. Each is focusing on a major topic of interest in engineering—for example, systems engineering for large structures at Lehigh University—with the aim of developing a center of excellence in its field. The Department of Transportation is in the process of creating ten regional university-based centers for R&D.

The Council also recognizes that the significant technical, financial, and legal risks involved with innovation can deter development and application. Risk-sharing arrangements for demonstration projects that test technology in an operating environment can help overcome these barriers. The size of many projects and the degree of risk involved may require a federal role. The federal government has assumed such responsibility in the past—most notably in the field of energy development—and the extent of our infrastructure needs may justify its doing so again.

Funding for efforts to expand infrastructure innovation should be provided by all levels of government and the private sector, with additional support from consumers as well. The latter could be collected in the form of a small assessment on utility bills earmarked for research and development in areas related to the source of funds. For instance, a 10 cent monthly assessment on year-round housing served by public sewers would yield over $77 million a year. A small percentage of public infrastructure capital funds also could be set aside for R&D. Potential sources include dedicated revenues, grants, trust funds, and general revenue contributions to capital budgets.

The Council also recognizes that to encourage and implement innovative technology, we must provide adequate education and training for the people who build, manage, and operate public works. These tasks demand increasingly complex technical and professional competencies, particularly in the areas of maintenance and rehabilitation.

Enrollments in schools of civil engineering—traditionally the mainstay of the public works profession—are declining significantly just as many senior engineers are reaching retirement age. Over the period 1985–1989, about 16 percent of all engineers in state transportation agencies are expected to retire; in some states the figure will exceed 20 percent. Yet between 1984 and 1987, the number of bachelor degrees awarded in engineering declined from 76,931 to 71,372. The share of degrees awarded in civil engineering has been falling rapidly: from about 20.3 percent in 1976 to 15.7 percent in 1982, and then to 12.8 percent in 1984. In addition, civil engineering graduates often have more financially rewarding job opportunities than are available in public works agencies.

The Council concludes that the nation has a shortage of technically competent personnel to meet future requirements of the public works profession. Federal action is needed to support and stimulate the education and training of public works professionals from all disciplines and academic specialties. Government agencies and private organizations should conduct an aggressive and sustained campaign to encourage young people to enter the profession. Major professional organizations such as the American Public Works Association and the American Society of Civil Engineers already have taken the initiative on this issue. However, they should receive much more active support from government, business, and the education community. In addition, specialists from a range of other fields who could apply fresh perspectives should be encouraged to join the public works profession. Finally, retraining and continuing education programs should be utilized to upgrade the skills and abilities of current staff members.

> *"There should be an immediate national concern for the provision of public works management training for the next generation of leaders in this field."*
>
> Max Whitman, Director of Public Works, Village of Winnetka, Illinois
> Council Hearing,
> Chicago, Sept. 30, 1987

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A Strategy for Improving America's Public Works

No single approach is adequate to ensure the future viability of America's infrastructure. A broad range of measures is necessary to make a meaningful difference by the turn of the century. Specifically, these should include:

- **A national commitment, shared by all levels of government and the private sector, to increase capital spending by as much as 100 percent above current levels;**
- **Clarification of the respective roles of the federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability;**
- **More flexible administration of federal and state mandates to allow cost-effective methods of compliance;**
- **Accelerated spending of the federal highway, transit, aviation, and waterways trust funds;**
- **Financing of a larger share of the cost of public works by those who benefit from services;**
- **Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing;**
- **Strong incentives for maintenance of capital assets and the use of low-capital techniques such as demand management, coordinated land-use planning, and waste reduction and recycling;**
- **Additional support for research and development to accelerate technological innovation and for training of public works professionals; and**
- **A rational capital budgeting process at all levels of government.**

None of these steps will be easy or unopposed. But the increasing cost of delay is certain. The Council urges the President, the Congress, and the nation's state and local leaders to act on this agenda immediately.

FRAGILE FOUNDATIONS: A REPORT ON AMERICA'S PUBLIC WORKS

FINAL REPORT TO THE PRESIDENT AND THE CONGRESS

PART TWO: SYNTHESIS OF COUNCIL RESEARCH

National Council on
Public Works Improvement
February 1988

CHAPTER I

THE IMPORTANCE OF THE NATION'S INFRASTRUCTURE

One measure of a nation's well-being is the quality and extent of services provided by its public works. Water supply and sanitation facilities help determine the quality of public health. Highway and transportation facilities influence social, political, and economic integration. Although not always visible or measurable, the effects of these facilities combine to shape the society in which we live.

Of all public services, infrastructure may be the easiest to take for granted. When it functions best, it is noticed least. By the time the public and the press focus their attention on the infrastructure (usually in response to system failure or severe and continued congestion), real damage has already been done.

As a nation, the United States has an obligation to support national defense, economic vitality and community well-being with safe and productive public works. The National Council on Public Works Improvement was directed by The Public Works Improvement Act of 1984, P.L. 98-501, to consider how the U.S. can meet those obligations most effectively.

This report presents a synthesis of the findings of nearly two years of Council research and outreach activities. This chapter sets the stage for the rest of the report by defining the public works studied by the Council, putting the concern with public works in historical perspective, and discussing the importance of public works to the nation's economy.

WHAT IS INFRASTRUCTURE?

The Council chose to study nine categories of public works infrastructure: highways, streets, roads and bridges; airports and airways; public transit; intermodal transportation (focusing on the interfaces between individual modes); water supply; wastewater treatment; water resources; solid waste; and hazardous waste services. These categories have strong links to economic development and, except for the last, a tradition of direct public-sector involvement. The facilities have high fixed costs and long economic lives. Because of the lack of comparable data, a discussion of intermodal transportation is not always included in category comparisons.

The nation's infrastructure comprises far more than the categories studied directly by the Council. Others include communications, power production facilities, railroads (which are largely private), schools, public housing, sidewalks, lighting, hospitals, public buildings, parks, and prisons. Taken as a whole, the services they provide form the underpinnings of our nation's defense, a strong economy and our health and safety.

The public works categories studied by the Council represent a capital stock of $1 trillion dollars and constitute almost 10 percent of the nation's total capital stock. Annual public sector spending on these facilities exceeds $100 billion, or nearly 7 percent of all government spending. This is equivalent to about 60 percent of what the government spends on health, and about 75 percent of state and local spending on elementary and secondary education. Some 7 million people (6 percent of those employed in the United States) work in public works construction, operation, and maintenance.

PUBLIC WORKS: PAST AND PRESENT

The importance of public works for promoting national defense and economic development has been recognized since the founding of this nation. Albert Gallatin, Secretary of the Treasury under President Thomas Jefferson, developed a plan for an elaborate network of canals and roads to promote national defense and economic development. He convinced Congress to finance the construction of these public works through an innovative intergovernmental grant arrangement. Through Secretary Gallatin's efforts, the act that admitted Ohio into the Union in 1802 earmarked 5 percent of federal land sales in the new state for building roads linking the state with the navigable waters flowing to the Atlantic.[1]

The initial product of this effort was the nation's first interstate highway—the Cumberland (or National) road. Due to general demand and the inaction of the states, the federal government maintained the road until it was ceded back to the states in the 1830s. As a result, the federal government became a major partner with the states in the development of internal improvements including wagon roads, canals, railroads, highways and other components of the nation's rapidly expanding transportation network. Over time, federal participation in such partnerships expanded beyond earmarked revenues from land sales to include providing supplies and technical services through the Army Engineers and participating in joint stock companies with state and local governments and private investors.[2]

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[1] George F. Break, "Fiscal Federalism in the United States: The First 200 Years, Evaluation and Outlook," in Advisory Commission on Intergovernmental Relations, *The Future of Federalism in the 1980s*, Report No. M-126, 1981, pp. 39-40.

By the 1820s and 1830s, 11 percent of the federal budget was devoted to building such internal improvements. These investments opened new markets and promoted national unity. Along with national projects, many 19th century state and local projects, such as the Erie Canal and the Brooklyn Bridge, were grand in scale and attracted widespread public enthusiasm and support. Not only did they help generate substantial new wealth, they were also a major source of civic pride.

At the turn of the 20th century, the nation's infrastructure grew enormously. Between the years 1888 and 1914, the number of waterworks grew from 1,800 to 10,000; sewer miles increased from 6,000 to 30,000; and transit miles from 5,000 to 35,000. Much of the core infrastructure (e.g., bridges, water systems, and sewers) standing today in America's older cities was put in place just after the turn of the century. The period around World War I also saw the start of the federally aided highway system. This immense activity was due to many factors, including the advent of new technologies, the availability of related engineering talent, and a heightened interest in public health and safety. Public enthusiasm helped break down barriers to change and the nation took advantage of technological opportunities.[3]

The post-World War II period also witnessed several major public works initiatives. In the 1950s Congress designated the National System of Interstate and Defense Highways, commonly known as the Interstate Highway System and created the Highway Trust Fund to finance it. The project was intended to promote interstate commerce, maintain America's international competitiveness, and strengthen the national defense.[4] Today, 22 percent of the nation's roads, accounting for 80 percent of the vehicle miles traveled, are part of the federal aid system.

In 1970, Congress passed the Airport and Airway Development Act and the Airport and Airway Revenue Act, which quadrupled annual airport appropriations for the next five years, made airport planning grants available for the first time, and set up an Airport Trust Fund to eliminate uncertainty in airport funding. The purpose of this initiative was to address complaints about noise, airport congestion, and lapses in air safety.[5]

More recently, growing concern about the quality of the nation's environment has led to federal legislation dealing with such matters as solid and hazardous waste disposal, safe drinking water, and wastewater treatment.

INFRASTRUCTURE AND THE ECONOMY

Over two hundred years ago Adam Smith wrote:

> The third and last duty of the sovereign or commonwealth is that of erecting and maintaining those public institutions and those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature, that the profit could never repay the expense to any individual or small number of individuals, and which it therefore cannot be expected that any individual or small number of individuals should erect or maintain. . . . [T]he works and institutions of this kind are chiefly those for facilitating the commerce of

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[2] Ibid., p. 40.

[3] Joel Tarr, "New Directions in Technology and Infrastructure," draft report from the School of Urban and Public Affairs, Carnegie Mellon University, p. 22.

[4] Public Works Historical Society, "Public Works and the Shaping of the Nation," prepared for the National Council on Public Works Improvement, September 1987, pp. 29-36.

[5] Ibid., pp. 44-47.

> the society, and those for promoting the instruction of the people.[6]

A recognition of this link between infrastructure and the economy prompted Jefferson to support internal improvements in a young and rapidly growing nation.

The connection between infrastructure and economic growth is generally accepted, but difficult to quantify. It is important to understand how infrastructure contributes to economic growth and it would be useful if further research were undertaken to better document that relationship.

Economic growth depends on many factors; some can be controlled by public actions while others, at best, may be only influenced by such actions. The factors beyond direct public control include:

- Socioeconomic characteristics of the population (such as age mix, education levels, family structures, and income distribution).
- Society's value systems (such as the importance accorded to hard work and saving for the future).
- International influences, such as trade pressures and migration.
- Competitive economic shifts among the economy's sectors.
- Improvements in technology and productivity.

While public policy can affect these forces, the influence is usually long-term and indirect. Factors that public action can control directly include:

- Governmental fiscal policies (deficits, surpluses, and spending).
- Tax policies and their impact on capital investment, consumption, and savings.
- Monetary policies and their impact on price levels and capital costs.
- Public works regulatory and spending policies.

While infrastructure is used as a tool to promote growth, these other economic policies are also significant. Fiscal policy determines how much is spent on public works, while tax and monetary policies help determine the cost of raising capital for public works construction.

In the early 1980s, there were several major studies of the nation's public works that raised serious questions about the infrastructure's ability to support current and anticipated economic activity.[7]

Despite the recent attention given to the condition of public infrastructure, research has not yet fully explored the relationship between public investment and private sector performance. That relationship has two dimensions: the effect of infrastructure on private sector productivity and capital investments and the difference infrastructure makes in regional growth.

Economic development depends on the advantages a location offers; firms seek areas offering greater opportunities for profit. In this context, public works investments are best thought of as production factors for private firms paid for indirectly through taxes, or directly through user fees. Thus, public capital can increase a firm's productivity either by complementing private investment, or by directly contributing to production.

A recent study estimated the relationship between infrastructure and private inputs in production. The study found that local public investment and private capital are complements.[8] This suggests that specific levels of public infrastructure are necessary to support given levels of private investment. While this relationship may change over time as a result of technological improvements, a balance must be maintained between public and private investment.

A sustained high rate of public capital formation tends to increase private-sector capital productivity and hence rates of return. There is evidence that suggests that the public capital stock may be low relative to the private capital stock. The result of this imbalance may be depressed rates of profit for the nation's private stock and equipment. Thus, by reorienting public spending to upgrade and expand the public capital stock, the productivity of the nation's workforce, our competitive position internationally could be improved.[9]

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[6] Adam Smith, *An Inquiry into the Nature and Causes of The Wealth of Nations* (Chicago: the University of Chicago Press, 1976), Volume two, p. 244.

[7] See for example, Associated General Contractors of America, *America's Infrastructure—A Plan to Rebuild* (Washington, DC: May 1983); Pat Choate and Susan Walter, *America In Ruins: Beyond the Public Works Pork Barrell* (Washington, DC: Council of State Planning Agencies, 1981); Congressional Budget Office, *Public Works Infrastructure: Policy Considerations for the 1980s* (Washington, DC: April 1983); and *National Infrastructure Advisory Committee Report to the Joint Economic Committee of Congress* (Washinton, DC: February 1984).

[8] Kevin T Deno, "The Short Run Relationship Between Investment in Public Infrastructure and the Formation of Private Capital," unpublished Ph.D. dissertation, University of Oregon, 1986.

It is important to understand the interdependence between public and private capital investment in order to understand regional development. Underlying most regional development strategies is a premise that an important share of regional capital investment must be in public capital stock. Furthermore, the scale and location of that stock may have an important effect on subsequent private investment, as well as on the decisions made by firms and households about where to locate.

There is increasing empirical evidence that public works investments do, in fact, contribute to the economic growth of regions and states.[10] A 1987 study by Garcia-Mila and McGuire, for example, found that public expenditures for highways and education help explain differences in the level of economic activity from state to state.

In sum, economists increasingly recognize and are better documenting the importance of public infrastructure in promoting economic development. The general consensus is that public infrastructure increases productivity and, by enhancing a region's amenities, attracts households and firms, further contributing to an area's growth. However, more analysis is needed in order to calculate the economic benefits of specific investment projects and to help set investment priorities.

Public agencies form the cornerstone in building and operating public works, but infrastructure services involve both private and public spending. For example, the U.S. has 3.8 million miles of highways carrying 175 million private cars and trucks. For every public dollar spent to build and operate the nation's roads and bridges, private firms and individuals spend $15; for every public dollar spent on aviation, the private sector spends $9 on civilian and commercial aviation.

Assuming moderate economic growth over the next decade, the Department of Commerce estimates that industry use of infrastructure will increase at an annual rate of 2.7 percent from 1984 to 1995.[11] The Department of Commerce projects use-by-category to grow as follows:[12]

Public Works Category	**Annual Rate of Growth**
Highways, streets, roads, & bridges	2.6 percent
Air transport	3.3 percent
Mass transit	3.4 percent
Water supply	2.6 percent
Sewerage	2.7 percent
Dams, reservoirs	1.9 percent
Water transport	1.4 percent
Solid Waste facilities	3.0 percent
Hazardous Waste facilities	NA

If there is no excess capacity to accommodate growth in public works facilities, capacity must increase at the same rate as use if service quality is to be maintained. To improve service quality, capacity must increase faster than use. Capacity can increase through better maintenance of existing stock, more efficient use of existing facilities, adoption of low-cost alternative service delivery systems, and through increased investment.

CONCLUSION

Private and public investment must be balanced to support stable economic growth. Inadequate infrastructure reduces productivity because industry substitutes private capital and labor for nonexistent or inadequate public infrastructure. In effect, firms compensate by using more capital and labor to produce the same output. Such ability to compensate is more available in growing than in declining areas.[13] As a result, inadequate infrastructure may exacerbate the downward spiral of depressed areas. The next chapter analyzes how well the nation's public works have been providing the services crucial to economic development.

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[9] David Alan Aschauer, "Is the Public Capital Stock Too Low?" (The Federal Reserve Bank of Chicago: October 1987.

[10] Randall W. Eberts, "Estimating the Contribution of Urban Public Infrastructure to Regional Growth," (Cleveland: Federal Reserve Bank of Cleveland, December 1986), Working Paper 8610; Teresa Garcia-Mila and Therese McGuire, "The Contribution of Publicly Provided Inputs to States' Economies," (Princeton University: July 1987), Woodrow Wilson School Discussion Series, (Princeton University: July 1987); and Urbanomics, "The Role of Public Works in Supporting Regional and Industrial Growth," prepared for the National Council on Public Works Improvement, September 1987.

[11] U.S. Department of Commerce, Office of Economic Affairs, "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services," prepared for the National Council on Public Works Improvement, July 1987.

[12] Ibid., Table 8, p. Executive Summary 15.

[13] Deno, op. cit.

CHAPTER II

REINVESTING IN AMERICA

The previous chapter concluded that public and private capital investments complement each other and that there is need for balance between them. This chapter looks at factors affecting the demand and supply of public works services in this light. Various dimensions of the demand for public works services suggest that such demand is increasing. Trends in infrastructure capital accumulation and spending, used as proxies for the capacity of current facilities to provide services, are then examined. These trends indicate that, although annual real per capita public works spending has been increasing over the last 25 years, public works spending has declined relative to total government spending, to the nation's total annual production of goods and services, and to the level of private investment. These trends suggest an inevitable imbalance between demand and supply that will eventually lower the level and quality of services being provided.

PUBLIC WORKS FACILITIES AND PERFORMANCE

Infrastructure's importance lies in the services it provides: the movement of people and goods, the provision of clean water, and efficient and safe waste disposal. The question is whether these services are adequate to meet the nation's demands.

Answering this question is more complicated than focusing on the physical facilities themselves. The performance of the nation's public works is a relative, not an absolute, concept. The demand for services comes from businesses, households, and the government. Demographics, individual preferences, production techniques, mobility, and the distribution of costs all affect demand. More should be known about the influence of these factors on the demand for public works services if the performance of public works is to be measured accurately and systematically.

The supply of public works services determines how demand will be met. Supply is determined by the condition of existing facilities and how the facilities are used. For example, in 1980 the General Accounting Office reported that 50 percent of the nation's wastewater treatment plants were in violation of discharge standards. They reported that about half these plants were not treating wastewater adequately because of operations deficiencies. The most prevalent problems were inadequate local operating budgets and under-trained operating staff.[1] Therefore, to the extent that they can be operated more efficiently, existing facilities can provide expanded services without additional capital investment.

The demand for services and the capacity to meet that demand determine the daily performance of individual public works systems. Monitoring performance is critical to evaluating the state of the nation's infrastructure and its ability to sustain economic activity. The next two sections examine factors that reflect and/or influence demand and supply forces. The dynamic forces underlying the performance evaluations summarized in the final section of the chapter are presented in depth in Appendix A.

DEMAND FOR PUBLIC WORKS SERVICES

We can examine the demand for public works services from three perspectives. *Needs studies* determine the funding required for particular programs based on engineering standards, surveys, and local inventories. *Use estimates* measure the services currently being provided by available facilities and project the level of services needed in the future. *Demand studies* measure the services consumers would use based on alternative prices. Each approach provides valuable information.

Needs Studies

Since 1980, there have been more than a dozen national needs estimates, reflecting projections for all public works services.[2] Other estimates have been developed at the state, regional, and local levels. But they have been of only limited use in informing the decisionmaking process.

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[1] General Accounting Office, *Costly Wastewater Treatment Plants Fail to Perform as Expected* (Washington, D.C.: November 14, 1980).

[2] For a review of major recent needs studies and analysis of the shortcomings of this approach to public works spending, see National Council on Public Works Improvement, *The Nation's Public Works: Defining the Issues* (Washington, DC: September 1986), Chapter III.

The traditional first step of such studies is to ask what is needed. The answer can be misleading because needs estimates often are based on engineering standards alone, unconstrained by budget limits. As a result, there is a tendency to overestimate required spending. For example, federal bridge replacement and rehabilitation estimates assume that every bridge will be restored or replaced, but many could be down-posted to handle lighter traffic, or closed entirely.[3]

In addition, needs estimates for the component parts of individual categories and across categories of public works are not usually comparable. Adding them together presents a misleading picture. Studies must take care to control for the inclusion of operation and maintenance expenditures, the periods of time over which estimates are made, the assumptions about economic growth and inflation built into the estimates, and the level of government and private involvement.

If technical standards alone drive needs estimates, they neglect site-specific conditions that can reduce the cost of providing comparable services. This is particularly true for wastewater treatment, where variable discharge permits are becoming more common.

It is rare for needs studies to consider ways of providing services other than through capital spending.[4] Needs estimates take little or no account of the provision of services; they focus only on facility costs. For example, water supply needs estimates can vary tremendously depending on consumer acceptance of water conservation measures.[5]

Needs estimates often assume no change in current policies. If funding formulas or cost-sharing conventions change, the demand for public works will almost certainly change. For example, most of the major deep draft ports recently authorized by Congress were scaled down (on average, by half) when the 1986 cost-sharing rules took effect. Similarly, recent empirical analysis estimated that the shift from a 75 percent to 55 percent federal match for wastewater treatment construction grants resulted in 30 percent less expensive secondary treatment plants.

Exhibit II-1 presents a range of needs estimates by category. While these

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[3] Alan E. Pisarski, *The Nation's Public Works Report on Highways, Streets, Roads and Bridges* (Washington, DC: the National Council on Public Works Improvement, May 1987), pp. 38-44.

[4] See for example, Wade Miller Associates, *The Nation's Public Works: Report on Water Supply* (Washington, DC: the National Council on Public Works Improvement, May 1987), Chapter II.

[5] Ibid.

EXHIBIT II-1

THREE NATIONAL NEEDS STUDIES:
COMPARISON OF ANNUAL CAPITAL INVESTMENT REQUIREMENTS
(in billions of 1982 dollars)

Infrastructure Category	AGC Study	CBO Study	JEC Study
	(19 yr. avge.)[a]	(1983-1990)	(1983-2000)
Highways and bridges	$ 62.8[b]	$ 27.2	$ 40.0
Other transportation (mass transit, railroads, airports, ports, locks, waterways)[c]	17.5	11.1	9.9
Drinking water	6.9	7.7	5.3
Wastewater treatment	25.4	6.6	9.1
Drainage	5.6	NA	—[d]
Total	$ 118.2	$ 52.6	$ 64.3

[a] The time frame for addressing needs varied by specific infrastructure category from five to 25 years.

[b] Highways only. Bridges were estimated separately at an additional, one-time repair cost of $51.7 billion.

[c] Needs for locks and waterways were not available from the JEC study, and needs for railroads were not available from the CBO study.

[d] Included under wastewater treatment.

Source: George Peterson, et al., *Infrastructure Needs Studies: A Critique*, a paper prepared for the National Council on Public Works Improvement by The Urban Institute, July 1, 1986.

estimates generally suggest the magnitude of service needs, they do not provide information to evaluate alternatives. A good needs study, from the decision-makers' perspective, would present and consider alternatives.

Use of Public Works Facilities[6]

Needs studies do not indicate how facilities are being used. Council research has attempted to measure the use of available facilities in order to provide a service-based rather than a structure-based measure of infrastructure requirements.

Between 1977 and 1984, the value of infrastructure services used increased by $15.1 billion (measured in 1977 dollars). Industry requirements accounted for $8.5 billion, or 56.3 percent of the increase; households accounted for $5.8 billion, or 38.4 percent; and others, including government, accounted for $0.8 billion, or 5.3 percent (see Exhibit II-2).[7]

Changes in industry requirements are influenced by changes in the relative importance of various industries, technological developments, and economic growth. This section considers each of these factors in turn, and their implications for national infrastructure policy.

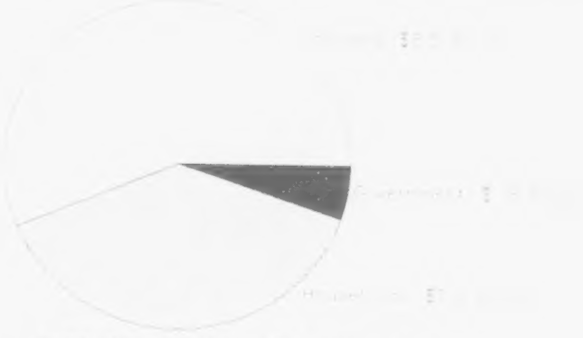
Structural change. The industrial makeup of the United States economy is always changing. Between 1972 and 1995, 7.5 percent of the total GNP is expected to shift from industries that produce goods to those that deliver services. The service, high-technology, and financial sectors will expand, while manufacturing and goods-producing industries are expected to contract in relative importance (see Exhibit II-3).

The expanding and contracting industries differ in ways that may significantly affect future public works use requirements. Firms in the expanding industries pollute less than firms in the contracting industries, and expanding-industry firms require lower materials input per unit of output than contracting-industry firms (see Exhibit II-4). Low-pollution industries will place less burden on the environment. Industries that use less material per unit of output will have lower transportation costs and waste disposal requirements.

The changing composition of the economy suggests that fewer infrastructure services may be required per dollar of economic activity in the future.

EXHIBIT II-2

SOURCE OF CHANGE IN ALL USES OF INFRASTRUCTURE SERVICES, 1977-1984



SOURCE: U.S. Department of Commerce, Office of Business Analysis

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[6] For a more thorough discussion of these issues, see U.S. Department of Commerce, Office of Economic Affairs, "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services," prepared for the National Council on Public Works Improvement, July 30, 1987.

[7] Ibid., Executive Summary, p. 16.

EXHIBIT II-3
CHANGES IN SHARE OF GNP FOR MAJOR SECTORS OF THE ECONOMY

	Percent of Total GNP			Change in Share of GNP	
	1972	1984	1995	72-84	84-95
Agriculture, forestry, & fisheries	3.28%	2.84%	2.48%	-0.44%	-0.36%
Mining	3.44	2.66	2.22	-0.77	-0.45
Construction	7.90	6.23	5.73	-1.66	-0.50
Manufacturing	30.09	26.75	26.86	-3.34	0.11
durable goods	16.91	15.91	16.71	-1.00	0.80
nondurable goods	13.18	10.83	10.15	-2.34	-0.68
Transportation & public utilities	9.54	10.08	11.03	0.54	0.95
transportation	4.15	3.79	3.59	-0.36	-0.20
communication	2.29	3.57	4.89	1.28	1.32
Electric, gas, & sanitary services	3.09	2.72	2.55	-0.37	-0.17
Wholesale trade	8.31	8.61	7.94	0.30	-0.66
Retail trade	11.55	11.03	9.94	-0.52	-1.09
Finance, insurance, & real estate	10.73	12.02	12.80	1.29	0.78
Services	13.69	18.38	19.69	4.68	1.32
Government enterprises	1.49	1.42	1.32	-0.08	-0.10

Source: U.S. Department of Commerce, Office of Economic Affairs, "Effects of Structural Change in the U.S. Economy On the Use of Public Works Services," A Report to the National Council on Public Works Improvements, July 30, 1987

EXHIBIT II-4
DIFFERENCES BETWEEN EXPANDING AND CONTRACTING INDUSTRIES WITH RESPECT TO SELECTED INDUSTRY CHARACTERISTICS

Industry Characteristic	Expanding Industries	Contracting Industries
Pollution intensity	low	high
Materials intensity	low	high
Scale of production	small	large
Capital intensity	low	high
Energy intensity	low	high
Transportability of products	high	low
Geographical dispersion of production	dispersed	concentrated

Source: U.S. Department of Commerce, Office of Economic Affairs, "Effects of Structural Change in the U.S. Economy On the Use of Public Works Services," A Report to the National Council on Public Works Improvement, July 30, 1987

Technological change.[8] Technological change may significantly alter transportation, communication, and waste disposal needs. Some observers project that within 20 years, most production and assembly will take place in computer-integrated flexible manufacturing systems. Such techniques may rely more heavily on just-in-time delivery systems. If this develops, production could take place much closer to major markets and inventories might fall dramatically. Increasingly, products could be shipped directly from manufacturer to final consumer. The beginnings of these trends are visible today in the increased importance of mail-order catalog sales and the use of television shopping.

To the extent that manufacturing becomes more decentralized, short-haul transportation could become more important, and long-haul transportation less important. Urban transportation systems, particularly peripheral ones, would become more complex as goods move directly from production to consumption sites. Thus, while the weight of materials carried per dollar of economic growth may decline, the complexity of the transportation supporting the industrial system may increase.

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[8] This section summarizes a discussion in Chapter III of the U.S. Department of Commerce report, "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services," which explores the implications of possible technological changes on the use of public works.

The spread of computer-integrated flexible manufacturing systems around the world could eventually reduce trade in manufactured goods relative to the total output of such goods. Similarly, technological advances may ultimately reduce trade in petroleum, agricultural products, minerals, and industrial raw materials. As a result, infrastructure devoted to handling goods and commodities (e.g., ports and docks) may be less in demand in the next century.

Advanced materials, such as composites, are becoming more commonplace. Because they are stronger and lighter than materials now in use, their incorporation in many vehicles will tend to reduce wear and tear on transportation infrastructure. However, their manufacture may increase the need for hazardous waste disposal capacity.

Declining energy prices and advances in such areas as membrane technology hold promise for new ways to deliver drinking water and to handle sewage. Large-scale recycling of sewage could become practicable. Sewage treatment could then increasingly occur at or close to its origin. As the recycling of water becomes more common, fresh water would be replenished in closed systems rather than replaced in open systems.

Cheaper energy and new technologies could also increase the nation's ability to cope with solid waste. Moreover, industrial solid waste may become less of a problem simply because there will be less of it relative to the volume of goods produced. Technology is improving production efficiency; industry growth may not mean increased growth of waste.

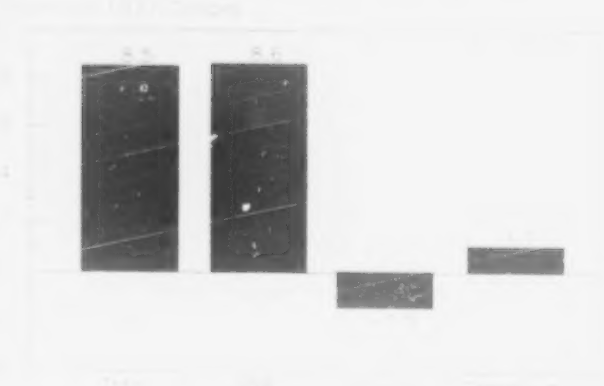
Advances in communication could contribute to a general decentralization of the economy, diminishing the need for people to convene in "main centers." Generally, communication may increasingly substitute for transportation.

To the extent that these projections are actually realized, they suggest that infrastructure requirements may not grow as fast as the economy over the long term.

Economic growth. Economic growth and geographic dispersion are increasing infrastructure use, but changes in technology and industry structure are offsetting part of the increase (see Exhibit II-5). Changes in the economy's structure and resulting changes in the delivery of goods and services have reduced the need for some infrastructure services. However, the overall effects of economic growth, dispersion, technological change, and changing industry structure will

EXHIBIT II-5

SOURCE OF CHANGE IN INDUSTRY USES OF INFRASTRUCTURE SERVICES, 1977 to 1984



SOURCE: US Department of Commerce, Office of Business Analysis increase industry infrastructure use by 2.7 percent per year until 1995, or by nearly one-third over a ten-year period. Thus, sustained economic growth will require a commitment to provide continued and reliable infrastructure services.

Demand Analysis[9]

One shortcoming of both needs and use analyses is that they do not consider the quality of services or facilities. Facilities may be congested, out of date, or inefficient; this influences the quality of services.

In consumer markets, the quality and quantity of needed goods and services are based on consumer demand, which varies with market prices for items. Society can supplement market outcomes and provide food, shelter, medical care, and education for those who cannot afford them in the open market, but individual decisions largely determine the goods to be produced.

Analyzing consumer demand to determine infrastructure needs is complicated by the fact that most infrastructure is financed by revenue sources that resemble taxes rather than consumer-paid prices. The absence of direct price signals means that political considerations often dominate economic ones in the decisionmaking process.

Many infrastructure services lend themselves to market-type pricing. Such prices (supplemented by general-fund subsidies where appropriate) could encourage more efficient capital construction and use decisions, improved service quality, and proper capital maintenance (this issue is discussed further in Chapter III). Wider application of market-type prices would require extensive information about the quality of services demanded and supplied and about consumer responsiveness to different price changes.

In summary, public works needs evaluations based on engineering standards, use, and demand analysis provide important information, but all have limits. Standards-based studies provide upper-bound measures of spending needs, but take no account of differences among facilities or localities, nor of changes over time. Use studies measure the contribution of infrastructure to output but do not reveal what users would do if faced with changed costs. Demand analysis can show how consumers value infrastructure services compared with other goods, but only if the prices charged reflect costs.

SUPPLY OF PUBLIC WORKS SERVICES[10]

In order to make informed investment decisions, measures of needs must be supplemented by information on the quality of services provided, the performance of facilities, and assessments of the cost-effectiveness of alternatives.

Current Public Works Facilities[11]

The process of estimating the capacity of public works facilities to provide services begins by examining the level of assets currently devoted to those purposes. The value of public works facilities in the Council's purview currently totals nearly $1 trillion. Real public works capital assets (expressed in 1984 dollars) have grown consistently since 1960 (see Exhibit II-6). Between 1960 and 1975, real public works assets per capita grew by about 40 percent from $2,767 to $3,889 an annual rate of growth of 2.3 percent. But, from 1975 to 1984, the rate of growth in per capita assets dropped to less than 0.1 percent a year.

Highways remain the nation's single largest public works capital asset. Today, as in 1960, highways account for 51 percent of capital assets. The relative importance of other public works facilities has changed considerably over time. The share of assets invested in water resources facilities (24 percent in 1960) fell to 15 percent by 1984 as capital acquisition slumped in the late 1970s and early 1980s. Water resources is the only category that has shown a net loss as a percentage of all assets, although it has grown in absolute dollar terms. Aside from wastewater, currently the fastest-growing category, public works capital has continued to grow at a moderate rate. Within the other environmental categories, water supply has remained unchanged (12 percent), while solid waste disposal has grown to represent a slightly larger portion of total assets (to a total of 0.3 percent). Solid waste disposal remains the smallest category, with $2.3 billion in assets in 1984. Aviation and transit assets, on the other hand, have doubled (see Exhibit II-6).

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[9] For a more detailed discussion of demand analysis and infrastructure decisions see Harvey A. Garn and R. Scott Foster, "Economic Considerations in Infrastructure Decision Making," prepared for the National Council on Public Works Improvement, September 28, 1987.

[10] For a more detailed discussion of these issues see Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," prepared for the National Council on Public Works Improvement, August 1987. Because hazardous waste facilities are predominantly private, consistent data on the value of such assets is not available.

[11] Expenditures on maintenance and operation affect the remaining life of capital assets. Such expenditures, however, have not been incorporated in estimates of net capital assets in public works. Therefore, the estimates are lower bounds and may overstate the trend in declining net capital value.

The trends in asset levels and public works use suggest that the nation is living on past transportation investments. In recent years, the use of highways and airports has grown twice as fast as investments (see Exhibits II-7 and II-8). As understanding of the nation's ecosystems improves, new environmental concerns will put growing demands on current water supply and waste management systems. Increasing imbalances are also suggested by the following data on actual spending trends.

Current Spending for Public Works

One common way to measure public works capacity is to analyze historical levels of public works spending. This approach reduces public works to a convenient dollar unit of measurement. However, it implies that some correct level of spending can be identified.

Real (or inflation-adjusted) spending for public works increased from about $60 billion in 1960 to $105 billion in 1985, an increase of over 70 percent (see Exhibit II-9).[12] Real spending on public works operations and maintenance almost tripled over this period, though real capital spending remained nearly constant. Annual per capita spending increased from $330 to $441.

While total real public works spending is increasing in absolute terms, it is declining as a government spending priority. Federal, state, and local governments together devoted 6.8 percent of their budgets to public works in 1985, down from 19 percent in 1950. At the federal level, this reflects a general decrease in the relative importance of nondefense discretionary programs and an increase in social programs during the 1970s.

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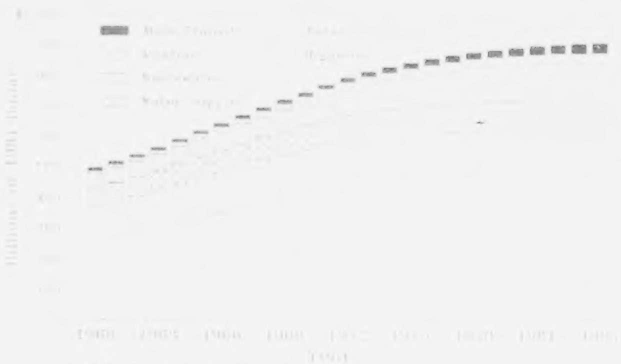
[12] All data in this chapter is presented in 1984 dollars unless stated otherwise.

EXHIBIT II-6
PUBLIC WORKS NET CAPITAL ASSETS
1960-1984*

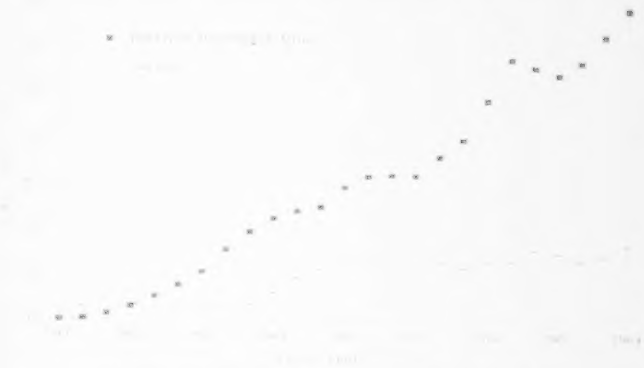


SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis

EXHIBIT II-7
COMPARISON OF TOTAL U.S. CAPITAL SPENDING FOR ROADS AND BRIDGES AND VEHICLE MILES OF TRAVEL

SOURCE: Apogee Research Inc. from U.S. Federal Highway Administration data

EXHIBIT II-8
COMPARISON OF PUBLIC CAPITAL SPENDING FOR AVIATION AND REVENUE PASSENGER MILES



SOURCE: Apogee Research, Inc. from the U.S. Department of Commerce, Office of Business Analysis and U.S. Department of Transportation data.

Exhibit II-9

PUBLIC WORKS SPENDING BY LEVEL OF GOVERNMENT
(dollars in billions, adjusted to 1984)

Year	Total	Federal		State		Local	
		$	%	$	%	$	%
1960	$60.4	$18.6	31	$17.3	29	$24.5	41
1970	83.8	23.0	27	26.8	32	34.0	41
1980	96.5	31.2	32	22.9	24	42.4	44
1985	105.0	28.5	27	24.6	23	51.9	49

Source: Apogee Research, Inc., based on data drawn from *Historical Tables, Budget of the United States Government, Fiscal Year 1987* Office of Management and Budget, (Washington, D.C.: Government Printing Office, 1986); *Governmental Finances* (various years), Bureau of the Census, United States Department of Commerce, (Washington, D.C.: Government Printing Office, selected years); and selected published and unpublished data from the following Federal Agencies: Farmers Home Administration, Economic Development Administration, Appalachian Regional Commission, Urban Mass Transit Administration, Federal Highway Administration, United States Army Corps of Engineers, and the Bureau of Reclamation.

Defense spending and interest payments on the national debt increased in the 1980s (see Exhibit II-10).

National public works spending is declining compared with most economic indicators. Despite the growth in dollar spending levels, public spending on infrastructure has dropped from 3.6 percent of the Gross National Product (GNP) in 1960 to 2.6 percent in 1985 (see Exhibit II-11). While spending on operations and maintenance has grown at the same rate as the GNP, capital spending has dropped from 2.3 percent of the GNP in 1960 to 1.1 percent today.

Public works investment is also growing more slowly than private capital investment. Investment in private-sector capital, including housing, increased from 13.7 to 16.5 percent of the GNP between 1975 and 1985. This increase more than offset the decade's one-half percentage-point decline in public works investment, resulting in a net increase in total investment of 2.3 percent of the GNP over the decade (see Exhibit II-12). Since public investment increases the productivity of private investment, this imbalance would suggest that such productivity will eventually decline.[13]

Public works spending trends provide contradictory evidence. On the one hand, continued spending growth demonstrates that increasing resources are being devoted to public works. On the other hand, public works spending is declining relative to both private capital and economic growth. This suggests that maintaining productivity and growth will require a greater commitment to public works in the future.

Investing for the Future

The trends in current spending on public works reflect, in part, the nature of those investments. All government spending is ultimately financed by taxes or user fees, but long-lived investments require access to capital markets for interim financing. Therefore, reduced savings rates, increased federal borrowing for other purposes, and dependence on foreign capital could impair the nation's ability to invest enough in public works to sustain a strong rate of growth.

Savings trends. Declines in public-sector investment echo eroding savings patterns in this country. Individual savings accounted for 3.6 percent of the GNP in 1985, down from 6.5 percent a decade earlier. Increased business savings made up for some of this decline, rising from 12.4 percent of the GNP in 1975 to 13.6 percent in 1985. On net, however, total savings dropped from 18.9 to 17.2 percent of the GNP over the decade (see Exhibit II-12).

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[13] Aschauer argues that because of the current imbalance between public and private investment, rates of return on private investment are already depressed. See David Alan Aschauer, "Is the Public Capital Stock Too Low?" *Chicago Fed Letter* (Chicago: Federal Reserve Bank of Chicago, October 1987). This assumes a constant technical relation between public and private capital which may not be valid if innovation in the private sector increases the productivity of a given level of public investment.

EXHIBIT II-10

ALL GOVERNMENT SPENDING, 1950-1984
in 1984 Dollars

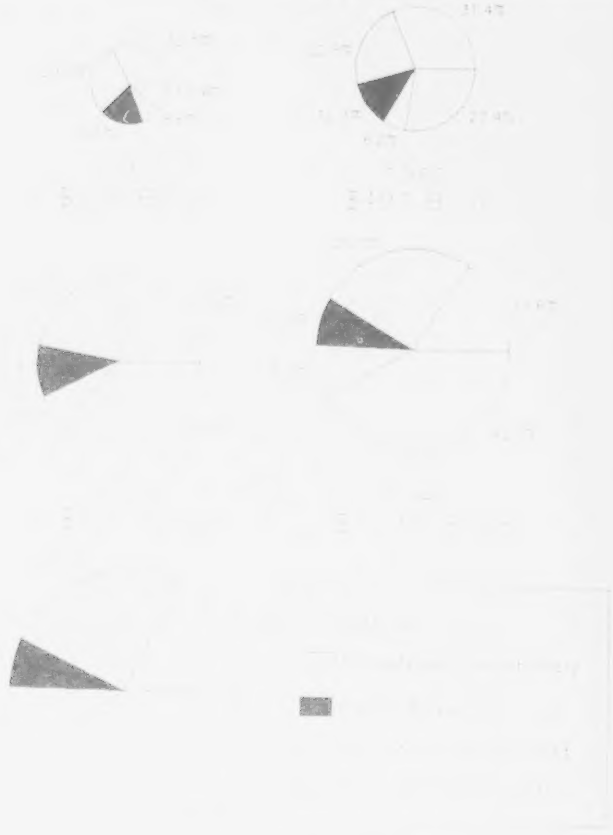
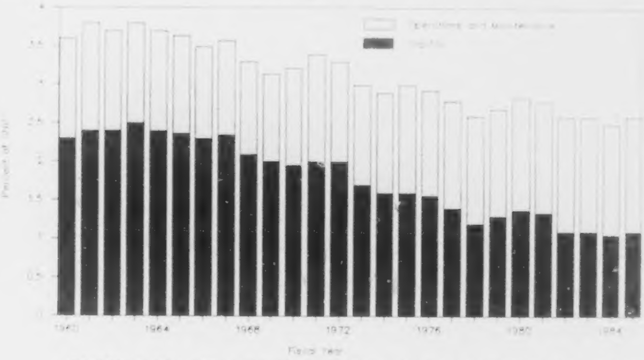


EXHIBIT II-11
PUBLIC WORKS OUTLAYS AS A PERCENTAGE OF GNP



SOURCE: US Office of Management and Budget, "Budget Appendices of the United States"; Bureau of the Census, "Government Expenditure Series"; and "The Economic Report of the President" for various years.

EXHIBIT II-12
SAVINGS AND INVESTMENT AS PERCENT OF GNP, SELECTED YEARS

	Gross Private Saving		Gross Investment	
Year	Personal	Business	Private	Public Works
1960	4.0	11.7	15.2	2.3
1970	5.7	10.5	14.7	2.0
1975	6.5	12.4	13.7	1.6
1980	5.0	12.5	16.0	1.3
1985	3.6	13.6	16.5	1.1

Source: NCPWI calculations based on *Economic Report of the President*, January 1987, Appendix B, and unpublished data provided by Apogee Research, Inc.

Government borrowing needs. Government borrowing needs have reduced the funds available for private capital formation by absorbing an increasing share of savings. Between 1975 and 1985, the share of new individual savings used to purchase government securities rose from 11.5 percent to 31.5 percent.[14]

Increased federal borrowing caused most of this increase. The federal debt more than tripled over this period, increasing from $576.6 billion to $1,827.2 billion. Outstanding state and local debt increased at a similar rate over this period, but at $571.4 billion, was less than one-third as large as the federal debt outstanding in 1985.

It is critical to note that state and local governments' drain on savings is offset in part by contributions to their advance-funded retirement plans.[15] In contrast, federal retirement plans are funded largely on a pay-as-you-go basis, creating no new savings.

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[14] *Economic Report of the President* (Washington, DC, January 1987), Table B-28.

What this government absorption of savings means for capital formation depends on how governments spend the borrowing proceeds. Many state and local governments face constitutional or statutory prohibitions against incurring operating deficits. Such localities incur debt only for capital outlays.

The federal government, in contrast, incurs debt for both operating and capital spending.[16] Federal borrowing is therefore less likely to increase capital formation or complement private capital investments than are state and local government borrowing.

Foreign Investment and U.S. Capital Formation. Americans have been able to increase investment and to finance large federal deficits without saving more in part because the United States is attracting increasing amounts of foreign investment. In 1986, the United States' international debt was $264 billion.[17] This total is more than double the U.S. international debt in 1985 and contrasts sharply with the average annual international surplus of over $65 billion that the United States maintained throughout the 1970s.

Not all components of the international debt have the same economic effects. Foreign purchases of U.S. corporate stock or real assets such as factories are not "debt" in the sense that interest must be paid regularly to the asset's owner. Rather, the return to the investor depends on the success of the enterprise. Foreign investors earn a return if their investments succeed, but U.S. workers, suppliers, and investors benefit as well. In a failure, foreign investors share the costs.[18]

However, the net U.S. balance in equity and direct investment accounted for only 25 percent of its international debt at the end of 1986.[19] Debt instruments, which do require an outflow of payments, accounted for the remainder.

This influx of foreign savings has allowed Americans to maintain a high rate of consumption. Foreign investment is not a bottomless source of capital, however. The income outflows needed to service the debt will come at the expense of future U.S. domestic consumption and investment, both public and private.

MEASURING THE CURRENT PERFORMANCE OF PUBLIC WORKS[20]

The previous three sections discussed various proxies for factors that influence the demand for and supply of public works services. None of the individual measures gives a clear or convincing picture of the state of the nation's infrastructure because they measure only certain aspects of either demand or supply. Only by looking at the interaction of those forces, as manifested in the daily performance of public works, can we gain insight into the state of the nation's public works.

Four Performance Measures

In light of its mandate, the Council undertook an assessment of the current performance of the nation's infrastructure; policy conclusions for the future can be valid only if based on an accurate picture of the present. Research sponsored by the Council measured the current performance of eight categories against four measures: physical assets, product delivery, quality of service, (see Exhibit II-13) and cost-effectiveness. The next section outlines a conceptual framework for evaluating public works performance based on these four measures. The following section then applies this framework to

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[15] Between 1980 and 1984 the percentage of new capital borrowing that was offset by contributions to state/local retirement plans ranged from 46 percent to 65 percent. These National Council on Public Works Improvement staff calculations are based on the U.S. Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC, 1987), and Board of Governors of the Federal Reserve System, *Annual Statistical Digest* (Washington, DC, various years).

[16] One important exception is the Federal-Aid highway program and its supporting Highway Trust Fund, which, under the Byrd amendment, operates in a pay-as-you-go manner.

[17] U.S. Department of Commerce, *Survey of Current Business*.

[18] This point is made in a staff study prepared for the Joint Economic Committee, U.S. Congress, *The Economy at Midyear: A Legacy of Debt*, undated, p. 12.

[19] In 1986, the U.S. ran a surplus of $52 billion in direct investment, which meant that this country invested that amount more overseas than foreigners invested here in physical facilities and real property. In contrast, the U.S. ran a deficit in corporate equity of $116 billion in 1986.

[20] For a more detailed analysis of the performance of individual categories of public works, see Appendix A and Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," op. cit.

EXHIBIT II-13
ILLUSTRATIVE MEASURES OF PERFORMANCE FOR THE NATION'S PUBLIC WORKS, BY CATEGORY

Public Works	Physical Assets	Service Delivery	Quality of Service To Users
Highways	Lane-miles Number of bridges Vehicle registration Fleet size	Passenger miles Vehicles miles Ton-miles	Congestion or travel time Pavement condition Volume/Capacity ratio Accident rates Population with easy access to freeways
Airports	Number of aircraft Commercial seat-miles Number and type of airports	Passener miles Enplanements Aircraft movements	Number and length of delays Accident rates Near miss rates Population with easy access
Transit	Number of buses Miles of heavy rail Subway seat miles Bus miles	Passenger miles Percent of work trips Transit trips	Average delays Breakdown frequency Population with easy access Elderly/handicapped access Crowding: passenger miles per seat-mile
Water Supply	Water production capacity Number of water facilities Miles of water main	Compliance with MCLs Reserve capacity Finished water production Fraction of population served	Water shortages Rate of water main breaks Incidence of water-borne disease Finished water purity Loss ratios
Wastewater Treatment	Capacity (mgd) Number of plants Miles of sewer	Compliance rate Reserve capacity Infiltration/inflow Volume treated Fraction of population served	Compliance with designated stream uses (local) Sewage treatment plan downtime Sewer moratoria
Water Resources	Number of ports, waterways Reservoir storage capacity Number of dams Miles of levees, dikes	Cargo ton-miles Recreation days Flood protected acreage Irrigated acreage Kwh hydropower produced	Shipping delays Dam failure rate Power loss rate Value of irrigated agricultural product Value of flood damages averted

EXHIBIT II-13

ILLUSTRATIVE MEASURES OF PERFORMANCE FOR THE NATION'S PUBLIC WORKS, BY CATEGORY (continued)

Public Works	Physical Assets	Service Delivery	Quality of Service To Users
Solid Waste	Landfill capacity Incinerator capacity Number of solid waste trucks	Tons of trash collected Tons landfilled Tons incinerated	Collection service interruptions Facility downtime Rate of groundwater contamination

Note: Possible measures of investment efficiency are not shown since these will show less variation by mode. They are discussed in the text.

an evaluation of eight categories studied by the Council.[21]

Physical assets. The simplest measure of infrastructure is the availability of physical assets. This measure is related to capital investment. Data on physical assets (such as numbers of buildings or rolling stock) are often readily accessible, but this information, by itself, does not show how well the assets are being used or the quality of service provided. An airport's physical assets, for example, could be measured by the number of its runways. But one runway in good repair might support more landings and takeoffs than several in poor condition.

Both public and private investment in public works facilities and other capital are important to the total overall measure of physical assets. For example, highway lane-miles are used to measure the public highway contribution, but privately owned cars and trucks are vital to producing highway transportation services. Substantial public expenditures support solid waste management services. However, recent data suggest that private expenditures are added to new solid waste capital at twice the public rate.[22] Although local governments own most water supply systems, there are about 15,740 privately owned water systems that serve about 38 million Americans.[23]

Service delivery. Service delivery measures the infrastructure's ability to perform at certain service levels. For example community water systems must deliver an uninterrupted supply of potable water; flood control structures must provide storage for floodwater levels expected once every 100 years.

Service delivery depends on three elements: the system's physical capacity, the quality of its operation and maintenance, and the level of demand for its service. For example, the movement of cargo on inland waterways depends on the miles and depths of channels, the condition of locks and dams, and the operation of reservoirs. In addition, the level of service varies according to the demand for commodities transported on the waterways and the competition from other modes of transport.

Quality of service. The quality of service reflects the physical size and condition of public works, the product being delivered, and investment and operating priorities. Quality measurements typically include accessibility, reliability, safety, health effects, and congestion. For example, transit access is measured by the population within walking distance of a bus or rail line. Calculations of accessibility also consider the special needs of such groups as the elderly and the handicapped.

Appropriate quality measures for municipal water systems include the frequency of water shortages and the incidence of water-related disease. Water quality requires the presence and operation of raw water extraction facilities, purification equipment, and distribution systems. The uninterrupted supply of pure water also depends on local water suppliers. Did suppliers anticipate the effects of drought or source contamination? Have operators complied with policy or regulatory mandates?

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[21] A ninth category, intermodal transportation, which concerns linkages between categories, is not examined separately in this assessment.

[22] Apogee Research, Inc., communication with Dr. Charles Johnson, National Solid Waste Management Association, July 1987.

[23] See Wade Miller Associates, *The Nation's Public Works: Report on Water Supply* op. cit., p. 18.

Economic performance. Economic performance measures can be divided into two broad categories: economic efficiency and cost-effectiveness.

Economic Efficiency: The economic efficiency of a project or program is reflected by the excess of its benefits over costs. Using the net present value approach to public spending analysis, we can discount such benefits and costs, using the appropriate social discount rate, for each year during the life of the project/program to the present time. These net benefits can then be compared with those of other programs so that current public resources can be allocated to provide maximum social benefit, i.e. the greatest net benefits. This approach is analogous to private sector capital budgeting models where the firm's profit reflects net benefits.

Such analysis, however, is not used systematically to evaluate governmental investments (except by the Corps of Engineers).[24] It is difficult to use rate-of-return analysis to rank and choose among alternative government investments,[25] in part, because it is difficult to define and value future public benefits. Moreover, using rate-of-return analysis for entire public works programs would require far greater data collection than is now used to support program decisions. Special factors also affect the assessment of governmental spending; for example, when considering the efficiency of the Interstate Highway System, national defense concerns must be taken into account.

The time lag between expenditures and delivery of infrastructure services makes it difficult to measure program investment efficiency. Finally, an often overlooked measurement problem concerns the interaction of public and private investments. For example, the private sector efficiency of highway and aviation services depends on their use by privately owned and operated vehicles and aircraft.

Cost-Effectiveness: The difficulties of measuring investment efficiency may make it more convenient to measure the cost-effectiveness of public works programs. Cost-effectiveness provides simpler measures of services delivered per dollar spent. It can compare the delivery of services with the financial and operating characteristics of facilities.[26]

Efficiency is only one goal of public works programs and sometimes it is ignored altogether. For example, the congressional statement of U.S. water quality policy in the 1972 Clean Water Act (P.L. 92-500) recognized that certain levels of pollution control are—*de facto*—worth their cost.[27] In practice, this led to enforceable standards that required the best controls technology could produce, with little concern for their cost.

It does not necessarily follow that because the benefits of a public works system outweigh its costs, users should be willing to pay, or indeed are able to pay, for particular services. The 1964 Urban Mass Transportation Act implied that the benefits of urban mobility, especially for low-income communities, outweigh the costs of providing transit. This justification is still used to support federal capital and operating grants. Individual transit users probably receive a quality of service greater than that for which they would be willing to pay. However, the system provides additional benefits in the form of reduced highway congestion, a more mobile labor pool, and more effective housing and urban renewal programs.

The Performance of Individual Public Works Categories

In most cases, all four measures must be considered to best understand their implications for a category's performance; then, together with the factors discussed below, the measures can begin to show system performance. We now describe the performance of eight categories of public works.[28] Naturally, the performance measures are more applicable to some categories than to others; nevertheless, taken together they provide a reasonable basis for comparison (see Exhibits II-14 and II-15).

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[24] For an in-depth discussion of the limitations of rate-of-return analysis in public decision making, see Apogee Research, Inc., "Infrastructure Issues: Problems and General Solutions," prepared for the National Council on Public Works Improvement, October 1986.

[25] For a recent example of the use of such efficiency measures to evaluate public works programs (the expected economic efficiency of the $12 billion air traffic control modernization plan), see Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan* (Washington, DC: August 1983).

[26] For additional discussion of project versus program efficiency and controlling for quality of service, see Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (Washington, DC: June 1985).

[27] See Joan Kovalic, *The Clean Water Act of 1987*, Water Pollution Control Federation, July 9, 1987.

Highways. The overall performance of the nation's system of highways, streets, roads, and bridges has been good. During the 1960s, while the country was building the Interstate Highway System, the net capital assets of the entire road network grew continually. Since the completion of the majority of the Interstate System, the accumulation of total net capital assets has slowed and even decreased as some roadways reached the end of their useful life. In 1984, however, net capital assets once again began to grow, due to additional capital spending made possible by the federal five cent tax increase on motor fuel, four cents of which goes to highways and one cent to public transit.

Although levels of capital spending have varied, vehicle-miles of travel on the entire system have risen steadily since 1960 at an average annual rate of 3.0 percent. As a result, existing capital facilities in highways, streets, roads, and bridges are being used at an ever-increasing rate. The quality of service (as measured by overall pavement conditions) generally declined through 1984, but pavement conditions have been improving since 1985. Congestion is an increasing problem, particularly in rapidly growing suburban areas.

Since 1960, vehicle-miles travelled per dollar of public spending have been increasing by 3.5 percent annually. This suggests that either the nation may be making more productive use of its roads and bridges, or the public sector is not spending enough to meet growing transportation needs, in essence living on past investments. To a certain extent, both were true through 1984. Beginning in 1985, however, increased user taxes, supporting greater investment, have helped spending keep closer to need. However, given increasing population, regional shifts and growing intersuburban travel patterns, the capacity of the nation's highway and road network will have to expand further to avoid serious problems in the future.

Aviation. Until recently, the aviation system has responded well to rising demands for service within the limits of existing capacity. However, projected growth in demand suggests that over the long term, capacity may be the system's biggest problem. One indicator of this trend is the decline in the number of public-use airports. However, those lost were small general aviation facilities that were replaced easily in the public system.[29]

The number of commercial airports has changed little over this period. Thus, to absorb the rapidly increasing demand (reflected by passenger enplanements), commercial airports and airlines have had to add capacity through additional runways, improved air traffic control procedures, and expanded terminal facilities. Some airports are exploring the use of pricing mechanisms to increase capacity through charging higher landing fees during peak demand periods to spread traffic flow more evenly throughout the day.

Ordinarily, increased demand for limited facilities would mean lower quality services. Measured by the number of fatal accidents, however, the quality of aviation services is actually improving. (Domestically, the number of fatal commercial accidents is so small as to show no statistically significant trend.) Even given this extraordinary safety record, the cost-effectiveness of the aviation system is improving rapidly. Passenger load factors, for example, used as an indicator of capacity utilization rates, have jumped significantly, particularly since deregulation in 1978. However, delays, congestion, and the limits of the air traffic control system are of increasing concern. If not addressed, they could compromise the overall safety of the system.[30]

Mass transit. While the post-World War I physical decline of the nation's mass transit was reversed during the 1970s, the output of the system has dropped relative to the growth in urban travel. The total number of transit vehicles now exceeds 100,000, an increase of 75 percent since 1970, while the estimated value of fixed assets is over $30 billion, more than double the $14 billion in 1970. Much of the increase in fixed assets and vehicles

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[28] The category of intermodal transportation is omitted for lack of comparable data.

[29] Private-use facilities over that same period have grown at an annual rate of 6.3 percent.

[30] In fact, reported near-collisions have increased in recent years, in part because of a vastly expanded system of reporting and data collection.

Exhibit II-14
CATEGORICAL ANALYSIS
PHYSICAL ASSETS AND PRODUCT DELIVERY

Mode	Physical Assets			Product Delivery		
	Measure	Time Frame (Yrs)	Annual Change (%)	Measure	Time Frame (Yrs)	Annual Change (%)
Highways	Net Capital Assets	1960-85	3.5	Vehicle-miles	1960-85	3.0
Aviation	Public Use Airports	1970-85	1.1	Passenger Enplanements	1970-85	6.5
Mass Transit	Vehicles	1970-85	1.8	Passenger Trips	1970-83	0.9
Wastewater	Net Capital Assets	1960-85	5.7	Volume of Wastewater Treated	1976-86	0.8
Water Supply	Net Capital Assets	1960-85	2.5	Water Delivered	1984	(a)
Water Resources:						
Flood Control	Dams	1960-85	3.3	Flood Storage	1960-85	2.3
Navigation(b)	Locks & Dams	1960-85	1.8	Ton-miles	1960-85	2.8
Solid Waste	Net Capital Assets	1973-84	1.9	Tons of Trash Per Capita	1986	(c)

Notes: (a) No time series available. Based on a 1984 survey, 39.7 billion finished gallons were delivered, an equivalent of 175 gallons per person per day.
(b) Inland water navigation only.
(c) No time series available. Estimated to be 1 ton per capita per year.

Exhibit II-15
CATEGORICAL ANALYSIS
QUALITY OF SERVICE AND COST-EFFECTIVENESS

Mode	Quality of Service			Cost Effectiveness		
	Measure	Time Frame (Yrs)	Annual Change (%)	Measure	Time Frame (Yrs)	Annual Change (%)
Highways	Pavement Conditions	1977-83	(a)	Vehicle-miles Travelled Per $ Pub Spend	1963-84	3.5
Aviation	Fatal Air Carrier Accidents	1970-85	-0.1	Passenger Load	1970-85	2.6
Mass Transit	Avg Hours Btwn Bus Bkdwns	1981-84	10.5	Trips/Bus-mile	1970-83	-0.8
Wastewater	Ambient Water Quality	1974-81	(b)	Unit Water Treated Per Dollar O&M	1976-84	-4.5
Water Supply	Water Losses	1982	(c)	Internal Rate of Return	1970-82	(d)
Water Resources:						
Flood Control	Damages Prvntd	1960-85	(e)	Benefits/$ Assets	1960-85	(e)
Navigation	Avg Tow Delay	1986	(f)	O&M Costs/Ton-mile	1977-85	-0.8
Solid Waste	Collection & Disposal Rtg	1984	(g)	Tons per Dollar O&M	1974-80	-0.7

Notes: (a) Measures exist on the basis of road type. No single measure is a good quality indicator.
(b) Although no detailed data exist, trends suggest little, if any, change.
(c) No time series data exist to assess the annual rate of change in water losses. In 1982, water losses as a percent of total production stood at 10-20 percent.
(d) Data for 30 California water systems suggest internal rate of return ranging from 2-14 percent on capital invested between 1970 and 1982.
(e) Erratic based on flood control structure and rainfall. Over the 1960-85 period, 78 percent of total possible damages were prevented.
(f) No time series available. Median delay was 23 minutes in 1986.
(g) Based on a 100 point scale (1 = best), the 1984 collection and disposal rating was 36.25.

represents replacement of facilities that had deteriorated badly during the 1950s and 1960s. However, major physical problems remain in the subway systems of large older cities such as New York, Chicago, and Philadelphia.

In part as the result of a large infusion of federal funds to purchase more buses, trips per bus-mile fell at an annual rate of 0.8 percent between 1970 and 1983. Labor productivity also declined, from nearly 14,000 vehicle-miles per employee in 1965 to under 11,000 in 1983. Costs per passenger, after adjusting for inflation, have more than doubled since 1970.

In addition, evidence indicates that transit is over-capitalized in many places.[31] Important exceptions occur in cities like New York that have large rehabilitation requirements.) This over-capitalization is reflected in the relative growth in the number of vehicles in the system compared to ridership. The number of transit vehicles grew by 2 percent annually from 1970 to 1985, while ridership over the same period increased at only half that rate. As a result, trips per bus-mile have fallen since 1970. On the other hand, it appears that the quality of transit services has improved. The annual improvement in the average hours between bus breakdowns has been exceptional (10.5 percent).

Much of the decline in performance is due to forces beyond the control of transit managers. The most important factors have been the increased suburbanization of jobs and residences, greater use of automobiles, and growing intersuburban travel.

Water supply. Relatively little data and few analyses are available to evaluate the performance of community water facilities on a nationwide basis. The few statistically significant samples of the nearly 60,000 water systems reveal a largely self-sufficient cross-section of publicly and privately owned utilities, the majority of which produce a high-quality product at reasonable cost. Nationwide, annual 2.5 percent growth in net capital assets suggests a continuing dedication to investment.

Yet, national numbers mask regional and facility variations. One such regional concern is the deterioration of storage and distribution systems in older cities, mostly in the Northeast. Some water systems in western states are beginning to have allocation problems; users compete as regional supplies are consumed.

Public water systems in all regions of the country face potential performance difficulties that could arise from (1) artificially low, subsidized pricing conventions that exacerbate revenue shortfalls and encourage over-consumption; (2) compliance with increasingly strict water purity standards, particularly among small systems with limited funds; and (3) acute or chronic source contamination, especially among groundwater users.

Wastewater. Wastewater treatment has made significant gains in the United States in the past decade. From 1978 to 1986, the total value of wastewater facilities rose 25 percent from $110 billion to $138 billion. This is the fastest growth rate of any of the infrastructure categories studied by the Council for which there is consistent data. This growth reflects the nation's commitment to preserving water quality. However, the volume of effluent treated increased by only 6 percent, from 26,205 billions of gallons per day (BGD) to 27,692 BGD.

There is some concern that asset values have increased about 4 times as fast as volume of effluent treated. Some suggest that these trends reflect increasingly inefficient use of wastewater treatment resources. However, it must be remembered that there has been an overall improvement in the quality of treatment—68 percent of all treatment plant capacity was secondary or greater in 1978, 82 percent was secondary or greater in 1986, and that 8 percent more of the U.S. population is now served by centralized sewage treatment facilities making a total of three-quarters of all inhabitants served by central facilities.

These improvements have served to hold the quality of the nation's waters at nearly a constant level over the past decade in the face of population and industry growth. Such growth and the emerging concern about nonpoint sources of pollution, groundwater contamination, and threats to wetlands are challenges to the nation's commitment to preserving our water quality.

Water resources: inland waterways and ports. The nation's waterborne transport system has performed moderately well over the past 25 years. Since 1960, the value of the physical assets of the inland waterway system has grown at an annual rate of 1.8 percent. During that same time, ton-miles of cargo handled grew at an annual rate of 2.8 percent. This represented 15 percent of all intercity freight traffic.

The quality of inland waterway transportation is based on such things as congestion at locks, processing time at locks, use rates, dollar losses due to delays, and the amounts of time that locks are inoperable because of system failures. However, these data are not readily available for time-series analysis.

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[31] Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," op. cit., p. 147.

The average delay per tow (a measure of congestion) is also a good indication of the cost of inadequate facilities. In 1986, the majority of lock delays occurred on the Ohio and Mississippi Rivers. Half of all those locks had average delays of 23 minutes or more.

The cost-effectiveness of federal spending on the inland waterway system can be measured by dividing the federal expenditures by the traffic the system carries. These federal costs per ton-mile for the entire system have dropped slightly (from $0.17 in 1977 to $0.16 in 1987.) However, this average masks large variations between certain segments. At $2.76 per ton-mile, for example, the Atlantic Intercoastal Waterway has been one of the costliest segments to operate and maintain over the last ten years. Operating and maintaining the Lower Mississippi segments, on the other hand, has cost only $0.11 per ton-mile.

Finally, there are 188 deep draft ports along the coastal United States and the Great Lakes. Since 1960, the tonnage handled by U.S. ports has nearly doubled, accounting for nearly 20 percent of world seaborne trade in 1985. In providing this service, maintaining channels at their authorized depth is crucial. While dredging may not be a major problem at a few large ports, smaller ports are more difficult to maintain. This concern is greater in view of the increasing cost of dredging and may require more attention in the future.

Water resources: flood control. Much of the information needed to analyze the performance of flood control programs is unavailable. Some information measuring the performance of major flood control dams exists, but very little is known about the thousands of local levees and dikes. An equally poor understanding of urban stormwater control facilities obscures their potentially significant role in reducing urban flood damage.

Since 1960, the number of flood control dams built by the Army Corps of Engineers has grown at an annual rate of 3.3 percent. Although the trend over the past two decades has been toward smaller projects, the rate of flood storage has increased by 2.3 percent annually (55 million acre-feet of storage have been added to the system since 1960).

It is also difficult to measure directly the economic or investment efficiency of flood control programs. One indicator is annual flood damage averted in relation to annual program capital costs. These measures suggest that the Corps' flood control dams have yielded returns substantially in excess of their costs.

Solid waste. An assessment of the performance of sôlid waste disposal nationwide is severely constrained by a lack of historical information. The amount of waste disposed of annually is estimated to be one ton per capita. Net capital assets have grown by 1.5 percent a year since 1973. Given the better current understanding of solid waste management in conjunction with recent initiatives at the federal, state, and local levels, assets probably will grow even faster in the coming decade. Yet these observations provide little, if any, indication of how well the assets are being used.

Indicators of quality of service and cost-effectiveness show that collection and disposal services are provided relatively well, but unit costs of collection and disposal, measured in tons per dollar of operation and maintenance, have increased significantly. This trend is due largely to a nearly three-fold increase in disposal fees, a trend that could continue because landfills are becoming more expensive, and more environmentally sound; also, there is greater use of more expensive waste-to-energy facilities.

Hazardous waste. Each year U.S. industries generate more than 2 tons of hazardous waste per capita. Federal and state laws regulate how these contaminants must be treated and disposed. But even when managed properly, these wastes pose significant risks to the environment and public health. In spite of the importance of this issue, very little is known about the current capacity of U.S. hazardous waste management facilities or the private sector's ability to add new capacity to meet future demand.

The vast majority of treatment, storage, and disposal facilities (90 to 95 percent) are onsite and managed by individual private firms. Data, though available in various forms, are inconsistent and difficult to compile. Thus, it is hard to determine if planned capacity will actually be put into place. Also, plans are dependent on the permit process, siting procedures, and government regulation. Finally, once facilities have been identified, it may be difficult to determine how much additional waste they can handle.

Estimates suggest that 265 million metric tons (MMT) of hazardous waste were generated in the United States in

1983.[32] This total will have fallen only marginally (to 260 MMT) by 1986. (These estimates exclude the hazardous wastewater regulated under the Clean Water Act.)

The Chemicals and Allied Products group of manufacturing industries accounted for 48 percent of all hazardous waste generated in the United States during 1983. Within this group the alkalies and chlorine industry accounted for nearly 14 percent, the industrial organic chemicals industry for almost 19 percent, and the agricultural chemicals industry for 7 percent.

The Bureau of the Census estimates that the private costs of hazardous waste management totalled nearly $2.5 billion in 1984.[33] In constant dollars, this represents a 75 percent increase in the industrial cost of hazardous waste management since 1976, the year that the Resource Conservation and Recovery Act (RCRA) was passed. Still, for most industries, the cost of hazardous waste management is equivalent to less than one-third of one percent of industry-wide sales.

Industrial spending for hazardous waste control plant, equipment, and operations increased from approximately $800 million in 1976 to $2.4 billion in 1984. After adjusting for inflation, this represented a 75 percent increase. These spending levels would double if industry were in full compliance with RCRA and the toxic control portions of the Clean Water Act.[34] Nonetheless, the expenditures appear relatively small when measured against Gross Domestic Product (GDP) of nonfarm business (0.08 percent in 1984), total investment in manufacturing plant and equipment (1.73 percent in 1984), or total manufacturing sales (1.27 percent in 1984).

CONCLUSION

Council research shows that while America's infrastructure is not in ruins, it is inadequate to sustain future economic growth. There is cause for serious concern. The demand for and supply of public works services jointly determine performance levels and quality of the services provided. While currently available measures of public works needs and demand have flaws, all suggest that public works needs are rising. Available measures of supply, in turn, suggest that our commitment to public works investment is lagging.

The imbalance between the growing demand and the supply is affecting the quality of services delivered. In the last decade, total annual spending on public works at all levels of government increased by over 17 percent. Based on Department of Commerce research, projected business needs alone would require almost double that increase in the portion of infrastructure capacity used by industry over the next decade.

The projected increase in service demands need not be met entirely by increased capital spending. Better public works management can improve performance to supply some of the needed increase. However, in order to satisfy increasing demand, continued and even increased investment will be necessary as a complement to improved efficiency. Given the long lead time necessary to put public works facilities into place, it is critical that action be taken now to avoid serious breakdowns in the future.

Wear on the nation's infrastructure, as well as new demands on it, are emerging at a time of increasing financial austerity. Without a disciplined approach to public works investment, declining infrastructure spending, eroding saving rates, and mushrooming budget and trade deficits could damage the nation's ability to maintain a growing economy.

The nation's investments in such public works as the Interstate Highway System, regional flood control projects, airports, and schools have addressed significant needs. Nonetheless, Council research suggests that current infrastructure investment patterns do not serve the nation as well as they should. These patterns promise to impose financial and economic burdens on succeeding generations far greater than were imposed on this generation.

The Council was asked to evaluate the present condition of governmental infrastructure investments and recommend to the President and the Congress steps necessary to improve the nation's infrastructure systems and their ability to sustain economic growth. The following chapters reveal much that is good about what governments at all levels are doing in planning, building, operating, and maintaining the nation's public works.

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[32] Apogee Research, Inc., *The Nation's Public Works: Report on Hazardous Waste* (Washington, DC: the National Council on Public Works Improvement, May 1987). This does not include hazardous waste treated in wastewater treatment facilities.

[33] These figures include the costs to manufacturing establishments only, but encompass both solid and hazardous waste management costs. See Bureau of the Census, *Current Industrial Reports: Pollution Abatement Cost and Expenditures* (Washington, DC).

[34] See Congressional Budget Office, *Hazardous Waste Management: Recent Changes and Policy Alternatives* (Washington, DC, May 1985).

However, Council research shows that, on balance, the nation's infrastructure is inadequate to sustain a stable and growing economy. To provide the level of services necessary to remove backlogs and satisfy future demands, the nation must make a commitment to increase the capacity of public works. As the following chapters show, capacity can be increased by using current facilities more efficiently, by performing better maintenance, and by pursuing low-cost alternative delivery systems. Such noncapital-intensive approaches can offset the need for new investment to some degree, but new capital investment must complement these efforts.

The remainder of this report provides a synthesis of Council research as it relates to developing a strategy for improving the performance of the nation's public works. Such a strategy includes:

- Meeting public works financing needs by increasing the share of costs borne by those who benefit.
- Improving accountability for public works by adjusting and more clearly defining the roles of the three levels of government and the private sector.
- Enhancing the performance of public works systems by using limited resources more efficiently.
- Accelerating innovations in public works.

CHAPTER III

FINANCING PUBLIC WORKS

This chapter explores principles that can be used to determine who should pay for public works; financing methods to implement those principles; the effects of recent federal tax code changes on infrastructure finance; and constitutional and statutory restrictions on state and local infrastructure finance.

WHO SHOULD PAY FOR PUBLIC WORKS?[1]

In private markets, the sale of goods and services finances their production. Consumer demand, together with available technology, dictates the producer's scale of operation and production levels.

Council research suggests that users could finance a greater share of many public works facilities. These include significant elements of transportation, water supply, wastewater treatment, and solid and hazardous waste systems. Because these facilities largely serve identifiable consumers, their use can be measured and priced; those who do not pay can be refused services.

By contrast, other public programs, such as national defense, police, prisons, and fire control, do not lend themselves to the identification of individual beneficiaries. Therefore, they are more appropriately financed through general revenues. Such financing divorces payments from resulting benefits.[2]

Charging beneficiaries directly for the cost of services has advantages. One such advantage is that all beneficiaries can be made to pay their fair share. This allocation of charges can help avoid the overbuilding that may come with the perception that anything "public" is free.

Financing mechanisms that reflect cost can help solve a fundamental financing problem stemming from the nature of public works facilities. Long-lived facilities with slow deterioration require large, intermittent building or replacement expenditures.

Use of public works facilities, on the other hand, is generally continuous. For example, water is used daily, trips to work are regular, and goods are shipped on a predictable basis. If financing is linked to use, revenue can become steadier and more predictable, encouraging better maintenance, rehabilitation, and replacement. But if use fluctuates in response to price changes or economic conditions, use-related financing mechanisms can disrupt orderly capital planning.

The beneficiary finance principle has certain limitations. Revenues that are not set at a level needed to finance the service or facility will not provide the correct resource-allocation signals. Also, isolating financing decisions on some facilities ignores the amounts to be spent on complementary services. In addition, if there are beneficiaries who cannot afford to cover the full cost of the service, general fund subsidies may be required. Specific beneficiary finance techniques are discussed below.

IMPLEMENTING THE BENEFIT PRINCIPLE IN PUBLIC WORKS FINANCE

Earmarked taxes, user fees, and the creation of special districts and authorities are three use-based financing techniques that the Council has studied in detail. Each is a way to link payments with benefits and to segregate these payments from other public funds, a process facilitated by trust funds. Each technique has certain advantages and limitations as a financing tool.

Earmarked Taxes[3]

Earmarked taxes are used for specific public spending programs or projects.

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[1] For a thorough discussion of the issues raised in this section, see Charles F. Adams, Astrid E. Merget, and Frederick D. Stocker, "Earmarking Revenues for Public Works Projects," prepared for the National Council on Public Works Improvement, July 1987; Harvey A. Garn and R. Scott Fosler, "Economic Considerations in Infrastructure Decision Making," prepared for the National Council on Public Works Improvement, September 25, 1987; and the individual categorical studies on public works prepared for the Council.

[2] This point is discussed in William H. Oakland, "Earmarking and Decentralization," *Proceedings of the Seventy-Seventh Annual Conference* (Columbus: National Tax Association, 1985).

[3] For a more detailed discussion of this topic, see Charles F. Adams, Astrid E. Merget, and Frederick D. Stocker, "Earmarking Revenues for Public Works Projects," op. cit.; and Steven D. Gold, Brenda Erickson, and Michelle Kissell, *Earmarking State Taxes* (Denver: National Conference of State Legislatures, 1987).

When such taxes are tied to the benefits provided, the tax functions as a user fee. For example, gasoline taxes are generally seen as indirect fees for highway use. While each type of tax is earmarked in at least one state, more than half of the states earmark a share of taxes on motor fuels, motor vehicle registrations, general sales, tobacco products, and alcoholic beverages.

The share of state taxes earmarked for various purposes has declined from about one-half in 1954 to about one-fifth in 1984, the latest year for which data are available.[4] The share declined despite steady increases in the number of state earmarking provisions, and reflects the relatively slower growth of revenues from earmarked taxes. Between 1954 and 1984, state collections of earmarked taxes increased nearly six-fold; state tax collections as a whole increased nearly nineteen-fold.[5]

When broad-based state sales and income taxes are earmarked, they are generally used for education and local government aid; less than 1 percent of state sales and income taxes is earmarked for public works (see Exhibit III-1). A larger share of state revenues is earmarked for aid to local governments, which can use them for public works. However, local government aid accounts for only about 2 percent of state sales and income tax revenues.

Illinois recently implemented an infrastructure program financed with earmarked taxes. "Build Illinois," an 8-year, $2.3 billion program, is designed to boost the state's economic development. This program emphasizes infrastructure, environmental and natural resources, business development, and educational and health facilities. The primary source of Build Illinois program money is the sale of Build Illinois Bonds, which are limited obligation bonds, supported by various revenues. These include a 5 percent sales tax on used cars, 50 percent of hotel and motel tax collections, $1.67 million from horse racing parimutuel taxes, and 1.75 percent of total sales tax collections.

Earmarking has many advantages for public works financing. It can be a way to introduce new spending programs or taxes in spite of fiscal austerity. Voters and legislatures are often more likely to approve a new tax if they can see a clear benefit from it.

For example, New Jersey officials believe that establishing the New Jersey Spill Fund helped increase state spending for cleaning up hazardous wastes. New Jersey levies a series of user and beneficiary fees dedicated to solving hazardous waste disposal problems. This program is estimated at $1.1 billion over a 5-year period. One component of this effort, the Spill Fund, is financed by a tax on petroleum and chemical manufacturers; officials estimate that the tax will yield $110 million over 5 years.

While earmarking had a large effect on the state's hazardous waste spending, New Jersey officials believe that

EXHIBIT III-1
STATE REVENUES EARMARKED FOR LOCAL GOVERNMENTS
AND FOR PUBLIC WORKS, 1984
(dollars in billions)

Revenue Source	Local Governments		Public Works	
	Total	Percent	Total	Percent
Sales and Gross Receipts Taxes	$3.3	4.6	$0.7	0.8
Income Taxes	2.5	3.9	0.4	0.6
User Fees and Other Charges	3.1	8.1	1.6	4.2

Source: NCPWI calculations based on data in Steven D. Gold, Brenda Erickson, and Michelle Kissell, *Earmarking State Taxes* (Denver, CO: National Conference of State Legislatures, 1987), p. 15; and U.S. Bureau of the Census, *State Tax Collections in 1984*.

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[4] Steven D. Gold, Brenda Erickson, and Michelle Kissell, *Earmarking State Taxes*, [illegible] Comprehensive data on earmarking of local taxes are not available. Earmarking at the federal level centers on various insurance trust funds, with 90 percent of all earmarked federal taxes accounted for by the Social Security trust funds, the federal unemployment trust fund, and the railroad retirement account (Adams, et al., p. 32).

[5] Calculations based on Gold, ibid., and U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC: 1987), table no. 432.

earmarking revenues for highways has less effect on spending for that program.[6] The highway program is larger and more established, with total spending far in excess of the earmarked amounts, while the hazardous waste program was a new program financed entirely out of earmarked revenues. The different effects in these two programs suggest that earmarking may be useful as a political strategy for initiating new programs, but may have less effect on spending for larger, well-established programs.

Earmarking has different effects in new and old programs in part because legislatures that feel unduly restricted by such provisions can offset them by reallocating other program funds. The earmarked funds then simply replace general funds that would have been spent in any event. This substitution is more likely if, as in the New Jersey highway program, earmarked revenues are less than program spending from all sources. If earmarked revenues are greater than total spending for the designated function, on the other hand, some increase in spending on the designated activity is likely.

The narrower the designated revenue use, the greater the spending effect. For example, earmarking local landfill revenues will have a greater impact on that facility's operation than a statewide tax dedicated to a broad range of environmental improvements.

Earmarking does not always lead to increased spending if the legislature must appropriate earmarked funds. For example, Congress has deferred appropriations from earmarked federal infrastructure trust funds (see "Trust Funds" section below). The state of Iowa, in particular, takes an unusual approach to spending earmarked funds. Earmarked funds not appropriated for specified projects or programs are placed in the general fund.[7]

Whether or not they actually increase spending, earmarking provisions can encourage improved program planning and management. A consistent and reliable revenue stream can help assure that funds are available when public works needs arise. This stability can compensate for short terms of office for elected officials and the prevalence of short-term budgeting at all levels of government. These features of the political system encourage a focus on short-term needs at the expense of long-term planning. Earmarking provides some certainty in financing so that those delivering the service can take a long-term perspective.

However, earmarking also has disadvantages. In Montana and Alabama, for example, earmarking provisions are so pervasive that they create serious fiscal management problems for the state, according to state government sources.[8] Attempts to roll back earmarking provisions are frustrated by the efforts of special-interest groups. Some of the fiscal rigidity imposed by earmarking could be mitigated by regulations that would allow such provisions to lapse absent legislative action. Also, earmarked taxes often produce less than the amount of revenue necessary for optimal support of the designated function.[9] Therefore, earmarking may not have a clear advantage over the ordinary appropriations process as a public works support tool.

In summary, earmarking can promote reliable funding for public works, but it must be used carefully. When earmarking limits budgetary decisions too stringently, it can bind elected officials to outdated priorities. When earmarking does not limit budgetary decisions, it is relatively ineffective, substituting dedicated funds for other funds that would have been spent in any event.

User Fees

User fees are payments by households, firms, or other consumers to a governmental body or other public works provider for services. User fees accounted for 9.9 percent of states' own-source revenues and 21.6 percent of own-source local revenues in 1985.[10]

Public works user fees generally do not cover the full costs of providing services.[11] For example, a recent survey discovered that, on average, wastewater utilities serving more than a million people set rates 11 percent below operating costs.[12] In 1985, user fees accounted for about one-half of all direct spending nationwide for sewerage and sanitation and nonhighway transportation facilities (parking facilities, water transport and terminals, and air transportation).[13] Only one-quarter of the 80 largest wastewater facilities in the United States derived 80 percent or more of their operating revenue in this way.[14]

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[6] Adams, et al., op. cit., pp. 73 and 111.

[7] Ibid., p. 61.

[8] Ibid., Part IV.

[9] Ibid., p. 46.

[10] NCPWI calculations based on Advisory Commission on Intergovernmental Relations, *Significant Features of Fiscal Federalism* (Washington, DC, 1987), Tables 34 and 35.

[11] U.S. Conference of Mayors and Arthur Young & Company, *User Fees: Towards Better Usage* (Washington, DC, 1987).

[12] Apogee Research, Inc., *The Nation's Public Works: Report on Wastewater Management* (Washington, DC: National Council on Public Works Improvement, May 1987), p. 151.

The way a user fee is set affects decisions about the use and expansion of capacity. A poorly designed user fee may provide a constant stream of revenue, but will not encourage the efficient use or provision of public works. Prices that are set to cover the cost of providing services can be used to allocate costs fairly and efficiently among different users and classes of users.

Evidence on the methods used to set user fees is scarce, although two methods are common. Average-cost pricing sets fees by taking the facility's estimated budget, less expected subsidies, and dividing by units of output or by users. A second method adjusts for operating deficits through rate increases, other internal revenue sources, or subsidies. Two rarely used methods believed to encourage efficient use and expansion decisions are pricing based on the marginal cost of providing an additional unit of service and pricing based on the cost of providing services during peak load periods.[15]

In several areas expanded user fees could help manage facilities' use and make certain facilities self-supporting. Airport user fees could help manage traffic and expand the capacity use of existing facilities. Some airports have begun using higher peak-hour fees to curb general aviation use of busy airports. Among these are New York's Kennedy and La Guardia airports, which in 1986 increased their landing fees for small aircraft from $5 to $25 during peak-use periods. The increase resulted in a 30 percent drop in general aviation air traffic during peak periods. The number of delays in takeoffs and landings decreased by 50 percent. Fees for peak period landings have since increased to $50.[16]

Full-cost pricing of water supply and wastewater treatment facilities could pay for a larger share of these services. To encourage full-cost pricing, loans from state revolving funds created under the 1987 amendments to the Clean Water Act (P.L. 100-4) could require that sewer rates cover operating expenses, debt retirement and a capital reserve fund for future rehabilitation of facilities.[17]

User fees can provide useful signals about capacity needs. When the U.S. Army Corps of Engineers implemented cost-sharing in 1986, nearly a third of the projects were redesigned at lower initial costs. For example, a projected expansion of Norfolk Harbor was to cost $400 million. To accommodate large modern coal ships, the project initially called for deepening the main channels from 45 to 55 feet and both inner channels to lesser depths, along with the construction of fixed mooring anchorage areas.[18]

Under a U.S. Army Corps of Engineers local cooperation agreement (LCA), the local port authority was required to contribute a share of the project cost. Faced with cost-sharing, the port authority decided to do the project in stages. Lightly loaded or empty inbound ships do not need as deep a channel. In the first stage, the depth of the outbound channel only was increased to 50 feet, at a total project cost of $50 million. Further deepening was deferred indefinitely.

In some cases, users should probably be charged less than the full cost of services. Mass transit, for example, benefits both riders and motorists who use less congested roads. To reflect this, it would be appropriate to supplement user fees with a general tax source, such as a regional sales tax or an earmarked gasoline tax, so that both indirect beneficiaries and direct users can help defray the costs. The share of revenue provided from general taxes should reflect the share of benefits accruing to indirect beneficiaries.

Likewise, waste disposal facilities benefit not only direct users who must dispose of waste products, but also those who generate hazardous wastes or produce difficult-to-dispose-of goods. About

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[13] Adams, et al., op. cit., p. 29.

[14] Apogee Research, Inc., *Report on Wastewater Management*, op. cit.

[15] Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provisions," prepared for the National Council on Public Works Improvement, August 1987.

[16] Apogee Research, Inc., *The Nation's Public Works: Report on Airports and Airways* (Washington, DC: the National Council on Public Works Improvement, May 1987), p. 131, and unpublished Apogee Research, Inc. information.

[17] Apogee Research, Inc., *Report on Wastewater Management*, op. cit., p. 152.

[18] Bory Steinberg, "The Initial and Expected Effects of Increased Cost Sharing," Institute for Water Resources, U.S. Army Corps of Engineers, 1986 (unpublished).

20 states impose taxes on wastes, ranging from $1 per ton in Wisconsin to $70 per ton in Minnesota.[19] Similarly, taxes on manufacturing certain difficult-to-dispose-of items could be used to finance disposal costs.[20]

User fees would not be appropriate for recovering the full costs of existing facilities that were built without considering user willingness and ability to pay. User fees may be applied most fairly to defraying the costs of new or additional capacity.

Financing public works to recover full costs through user fees also has potential disadvantages and socially undesirable outcomes. The poor and those living in hard-to-serve areas might find public works services unaffordable if the services are priced at full cost. Society has an interest in making sure that the environment is protected and that water and sanitation facilities are universally available, even if a particular facility cannot be supported solely by its users. Selective general-funds subsidies can help make services affordable when necessary.

A special application of the user-fee concept has emerged in public works financing in growing areas.[21] Local requirements governing new development have long included the provision of onsite infrastructure such as sewer and water connections. In the last decade, many localities have also begun to require developers to finance offsite infrastructure expansion or construction. Such requirements are implemented through development fees and exactions. Development fees are set or negotiated charges imposed on developers to finance infrastructure, while exactions are facilities built by developers and dedicated to the city.

In many states, municipalities are not empowered to impose such charges. Where they are, courts have often set constraints, generally insisting that the affected properties be clearly benefitted by the facilities and that the share of the cost borne by the properties be reasonable. Administrative systems that meet legal requirements are not simple. They often require sophisticated staff, computerized information systems, and highly professional planning of infrastructure and land use.

The use of development fees is most prevalent in California, Florida, and Colorado. Many cities and counties in these states use these fees to finance a broad range of infrastructure. Anne Arundel County in Maryland, which contains Annapolis, the state's historic capital, recently adopted a county-wide system of fees to finance expansion of its overburdened roads and schools. Declining areas will be unable to draw on these fees as a financing resource, however, since they require demand for new locations in order to succeed.

Development fees and exactions are controversial public finance tools. Opponents of their use argue that providing community-wide infrastructure is a local government responsibility for which everyone should pay, and that newcomers to an area should not bear the major cost of correcting problems created before their arrival. Opponents also claim that these fees increase housing costs.

Advocates argue that these fees are needed to avoid an inequitable distribution of the infrastructure burden created by new development. New development, they argue, generally leads to higher taxes and utility bills when needed infrastructure is financed from traditional revenue sources, even though new homeowners pay taxes and utility bills just like everyone else.

While these fees raise thorny administrative, legal, political, and technical problems, their size suggests that they are on the local-finance scene to stay. For a typical single-family house, these fees average $5,625 in Boulder County, Colorado; $4,421 in Orange County, California; and $6,107 in California's San Francisco Bay area. Anne Arundel County plans to charge $2,929 for each single-family house and $1,966 for each 1,000 square feet of office space.

Nevertheless, despite their size, these fees are not a panacea for localities struggling to pay for public works. Broward County, Florida, a growing area that uses these fees extensively, estimates that they cover only about one-third of the direct costs of providing public works for new development.

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[19] Apogee Research, Inc., *The Nation's Public Works: Report on Hazardous Waste Management* (Washington, DC: National Council on Public Works Improvement, May 1987), p. 181.

[20] R. W. Beck and Associates, *The Nation's Public Works: Report on Solid Waste* (Washington, DC: National Council on Public Works Improvement, May 1987), p. 90.

[21] This discussion draws on Thomas P. Snyder and Michael Stegman, *Paying for Growth: Using Developer Fees to Finance Infrastructure* (Washington, DC: Urban Land Institute, 1986).

Estimating the impact of these fees on public works decisionmaking and on the cost of housing for various income groups is difficult, since no national data are available on their prevalence and few guidelines for their use exist. Fees are also frequently negotiated between the community and the developer, with the result that similar developments may face very different charges. Judicial decisions have established some guidelines for using these fees fairly, but many questions remain unanswered. Further research is needed to determine the impact of fees and exactions on housing costs and to provide fee-setting guidelines.

Special Districts and Authorities

Special districts are limited-purpose governmental units with the power to levy taxes, user charges, and other fees. Public authorities perform similar functions but are not considered units of government for the purposes of debt liability or state constitutional restrictions. Both offer a way to shift infrastructure financing away from all taxpayers to those directly served.

Special districts and authorities are the nation's most rapidly growing form of government. There are 28,588 such districts currently in operation, comprising over one-third of the governmental units existing in 1982.[22] Over 36 percent of these districts provide public works, accounting for about 15 percent of public works spending in 1982, the last year for which data are available.[23]

Special districts for public works allow localities to finance public facilities that they might not be able to finance through general-purpose governments. There is some evidence that states that impose tax or spending limitations on localities tend to rely more heavily on special districts and authorities.[24] This may indicate that local governments in these states are less able to meet public works needs.

A state's fiscal capacity, or taxable resources, also influences its need for special districts and authorities. In general, states with lower fiscal capacity show a greater increase in the number of public works special districts and more rapid increases in spending by those districts than do states with higher capacity.[25]

Special districts also offer a way for governments to cooperate in dealing with public works issues that affect more than one government. Special districts that transcend jurisdictional boundaries can help ensure that a facility is constructed and operated on an optimal scale.

Evidence that special districts actually achieve these advantages is mixed. Their use may offer a way to surmount fiscal, bureaucratic, or geographic limits of general-purpose governments. However, these benefits may result in a loss of political accountability to voters and to the general-purpose governments that sustain the districts.

Accountability varies widely. The commissioners of the Ronald Sewer District in suburban Seattle are publicly elected and subject to voter recall.[26] Some districts in Colorado, in contrast, are so anonymous that in recent years they have not even been listed in local telephone directories.[27] If special districts and authorities are used to provide public works, they should be structured to ensure accountability to voters or to the general-purpose governments that create the districts.

It is also difficult to compare funding and resource allocation patterns of special districts with those of general-purpose governments. User fees do not often make a facility self-supporting (an exception would be such facilities as toll bridges and toll roads, where self-financing is frequently required by provisions of the revenue bonds used to finance them.) As a result, own-source revenues (mostly user fees and directly levied taxes) account for only about 50 percent of special district spending nationwide.[28] The remainder is made up of intergovernmental (largely federal) aid, which is financed by general revenues. Since special districts depend on general-purpose governments, they are still affected by the budgetary pressures, priorities, and funding interruptions of these governments.

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[22] Institute of Public Administration (IPA), "The Role of Special Districts and Public Authorities in Public Works Provision," op. cit., p. 41.

[23] Ibid.

[24] Advisory Commission on Intergovernmental Relations, *State Limitations on Local Taxes and Expenditures* (Washington, DC: U.S. Government Printing Office, 1977), p. 23.

[25] Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provision," op. cit., p. 52.

[26] Conversation with Sydell Pollin, manager, Ronald Sewer District, Seattle, Washington.

[27] Conversation with Peggy Cuciti, consultant to NCPWI.

[28] Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provision," op. cit., p. 137.

Special districts and authorities offer a way to solve problems that transcend general-purpose government boundaries because, theoretically, they can be large enough to deal with such problems. In practice, however, their scales of operation are generally not large enough. In particular, water supply and waste disposal often require broader policymaking and coordination than currently exist.[29]

Local turf concerns can be barriers to creating operating districts and authorities on an adequate scale. Many examples attest to the difficulty of interjurisdictional cooperation: efforts to regulate Texas and California water districts; efforts to get profitable automobile-oriented authorities to contribute to local streets and mass transportation; efforts to reduce water pollution by getting sewer districts to upgrade wastes disposed; and the resistance of airport management to neighboring community demands.[30]

Authorities and districts that try to be self-financing, or those that represent limited community interests, do not readily or voluntarily enter large cooperative or regulatory relationships even when public works problems extend beyond geographic or functional lines. Since special districts derive their authority from the states, states have the most leverage in helping special districts obtain the scale and accountability they need.

Some special districts are better able than general-purpose governments to maintain existing facilities in good repair, but this advantage is not universal. The maintenance and rehabilitation record of districts and authorities ranges from excellent to poor, as it does for cities and other governments. In cities with budget problems and deferred public works maintenance, facilities operated by districts and authorities also suffer from disinvestment. This suggests that an area's economic vitality has at least as much effect on its public works' condition as the area's governmental structures.

Districts and authorities that have not deferred maintenance are those with strong and independent sources of income that are protected from cuts in times of tight budgets. Profitable facilities tend to be better maintained than those that produce deficits, such as rail transit systems. Earmarked taxes associated with bond issues can protect operating budgets, while dependence on operating subsidies from general purpose governments makes them more vulnerable.[31]

In summary, special districts and authorities for public works provision can offer ways to transcend the fiscal, bureaucratic, and geographic limitations of general-purpose governments. Since their revenue streams are segregated from competing priorities, districts theoretically could make better scale, pricing, and maintenance decisions.

In practice, however, the fact that most districts are not self-supporting means that they are not insulated from the funding problems of general-purpose governments. Inadequate techniques for setting prices and political limitations on the scale of operations further limit the advantages of districts and authorities. Inadequate accountability and coordination with general-purpose governments can also limit the effectiveness of special districts. Where these districts are used, care should be taken to assure that they are accountable to voters or to the general-purpose governments that create the districts.

Special districts have the clearest financial advantage in providing public works if the service can generate a profit or if fiscal limitations prevent general-purpose governments from assuming further responsibilities.

Trust Funds[32]

Earmarked revenues accruing to both general-purpose governments and special districts are frequently segregated in trust funds or enterprise funds. These revenues are then both visibly dedicated to their designated purpose and available when spending needs arise. A trust fund operates essentially like a checking account: tax collections are credited to the trust fund account and balances are spent when trust fund obligations come due. In recent years, the federal government has limited the amounts to be withdrawn from the highway, transit, and airport trust funds, resulting in a build-up of balances in these accounts.

Most federal spending on transportation and more than two-thirds of all federal outlays for public works are financed through four federal trust funds (see Exhibit III-2). Excise taxes and interest on trust fund balances provide nearly $19 billion per year in income.[33]

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[29] Ibid., pp. 151-152.
[30] Ibid.
[31] Ibid.
[32] This section draws on Apogee Research, Inc., "Federal Trust Funds: Options to Use the Cash," prepared for the National Council on Public Works Improvement, September 28, 1987.

Fiscal year 1987 spending from these trust funds was nearly $17 billion. Nearly $14 billion of this total came from the Highway and Mass Transit Accounts of the Highway Trust Fund; most of the remainder came from the Airport and Airway Trust Fund. States and localities also frequently establish trust funds.

EXHIBIT III-2
FEDERAL PUBLIC WORKS TRUST FUND SUMMARY, 1987
(dollars in millions)

Trust Fund	Revenues	Outlays	Cash Balance
Highway Trust Fund			
Highway account	$12,727	$12,801	$9,412
Transit account	1,583	668	4,202
Airport and Airway Trust Fund	3,940	2,631	9,935
Inland Waterways Trust Fund	65	24	301
Harbor Maintenance Trust Fund	53	52	0 [a]
TOTAL	$18,368	$16,176	$23,850

[a] Any year end balances are returned to the Treasury.

Source: Apogee Research, Inc. from Appendix, Budget of the United States Government, Fiscal Year 1988.

Like many state legislatures, the Congress must authorize and appropriate spending financed by trust-fund balances. The recent accumulation of trust-fund balances has been motivated in part by federal budget problems and the way trust-fund income and spending enter the budget accounts. The federal budget deficit measures the difference between the federal government's receipts and its outlays. Trust funds have been part of the unified federal budget since 1969. Trust-fund outlays translate directly into increases in the deficit just as excise tax receipts credited to the funds decrease the deficit. Trust-fund spending would be deficit-neutral if annual spending exactly equaled each year's income.

Every trust fund requires some cash to balance any mismatch between the timing of revenues and outlays and to provide a cushion against unexpected swings in income or spending. The federal trust funds, however, have accumulated cash balances that far exceed those required to balance the anticipated pattern of future revenues and spending commitments.[34]

Some observers feel that the intrusion of federal budget concerns into decisions about trust-fund spending undermines the trust-fund concept. Accordingly, policy options for insulating trust-fund spending from the budget process have emerged in public policy debates. The range of options includes the following:

- Increasing spending.
- Removing trust funds from the budget.
- Turning back functions and revenues to state and local governments.
- Converting trust funds to private operation.

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[33] Cash balances held in federal trust funds are invested in special Treasury securities which are different from those marketed to the general public and are not counted as part of the outstanding federal debt. These securities earn interest, which becomes income to the trust funds.

[34] Apogee Research, Inc., "Federal Trust Funds: Options to Use the Cash," prepared for the National Council on Public Works Improvement, September 28, 1987, p. 15.

Increasing spending. One way to reduce trust fund balances would be to increase spending for the designated purpose. Because of the way the federal government does its accounting, this would add to the deficit, but would do so slowly, since capital projects spend money over extended periods of time. This strategy, however, would not necessarily benefit public works. Congress sets limits on budget authority and outlays by broad functional categories called "budget functions." All transportation programs are included in one budget function. Increased spending for programs financed through trust funds could force an equal decrease in related programs that are financed through other means.

Removing trust funds from the budget. Removing trust funds from the budget would eliminate their effect on the deficit. This would, however, make the federal budget less meaningful in that it would not reflect total federal revenues and spending. In addition, this removal would be unlikely to stimulate new spending, since the budget process also limits "off-budget" spending.

Turnbacks. The taxes that finance trust funds and the accompanying spending responsibilities could be turned over to state and local governments. The federal excise taxes that finance the trust funds could be eliminated, allowing state and local governments to collectively broaden their own tax bases with no apparent change for the consumer.

State and local governments might, however, place a lower priority on public works spending than do Congress and the administration. If state and local governments chose to pass the reduction in taxes on to taxpayers, or to spend the revenues on other programs, a continuing federal role in public works could still be required to assure that national interests are served.

Operating trust funds privately. Perhaps the most extreme suggestion for decoupling budget policy and trust-fund spending is to turn over trust-fund responsibilities to private corporations that would manage the associated infrastructure responsibilities. These agencies would be similar to special districts or authorities at the state and local level and would offer some of the same advantages and disadvantages.

In devolving infrastructure operation to the private sector, Congress would be giving up control over public works spending without necessarily giving up either political or fiscal responsibility for the quality of public works services.

In summary, many alternatives to current federal public works trust funds would probably create as many problems as they would solve. Moving trust funds off budget or turning them over to state and local governments or private firms could mean a loss of federal control over policy. However, certain national interests in public works, such as promoting efficient transportation and assuring environmental quality, cannot be abandoned. Even with the restrictions on trust fund spending imposed by the federal budget process, increasing public works spending may be best accomplished by making the case for public works within that process, rather than by establishing institutional structures to override it.

THE FEDERAL TAX CODE AND PUBLIC WORKS FINANCE

The Tax Reform Act of 1986 represents the most thorough and fundamental restructuring of the tax code in over 40 years. The law was intended to reverse the tax base erosion caused by proliferating tax preferences, reduce the distortion of economic decisions caused by high marginal tax rates, and increase the tax code's equity by relieving many low-income people of taxes.

The law's changes will affect state and local spending, taxing, and borrowing, as well as private-sector investment in public works capital. Four features of the law particularly affect state and local governments:

- Broadening the federal personal income tax base.
- Reducing marginal tax rates and eliminating sales tax deductibility.
- Limiting the volume of state and local borrowing for projects classified as private activities and raising the cost of tax-exempt borrowing.
- Reducing tax incentives for certain private investments and for public-private partnerships in providing infrastructure.

Broadening the Federal Personal Income Tax Base

Many state income tax codes use the federal definition of income or tax liability in calculating state taxes. The broadening of the federal income tax base has generated windfall tax increases for some states.

Reducing Marginal Tax Rates and Eliminating Sales Tax Deductibility

Federal tax deductions for state and local tax payments reduce the effective cost of state and local government services to itemizing taxpayers. Removal of these provisions will increase effective state and local tax rates and is expected to reduce voters' desired level of state and local spending.

At the same time, however, the law reduces federal individual income taxes by over $122 billion between 1987 and 1991 compared with prior law.[35] This reduction increases disposable income and may make it easier for state and local governments to raise additional tax revenues.

Limits on Tax-exempt Borrowing

The 1986 tax law limits the growth of tax-exempt bonds; increases state and local borrowing costs; and, through tax rate reductions and other provisions, reduces the tax advantage resulting from the interest exemption. Provisions that will increase state and local borrowing costs include the requirement that most state and local government arbitrage earnings be rebated to the federal treasury; discontinuation of the deductibility of interest expense for carrying tax-exempt obligations; and inclusion of interest on tax-exempt private-activity bonds in adjusted gross income for computing individual alternative minimum income tax liability.

The law's restrictions on state and local government borrowing were motivated in part by the explosive growth of tax-exempt borrowing for essentially private activities, such as industrial parks and student loans. The annual volume of revenue bonds grew from $14.5 billion in 1975 to $130.6 billion in 1985, and increased from 47 percent to 83 percent of state and local borrowing over this period.[36] In 1984, the last year that state and local borrowing was not affected by the anticipation of tax reform, 23.1 percent of the revenue bonds issued by state and local governments were issued to finance projects falling within the Council's definition of public works.[37]

To slow the growth of revenue bonds, the law established new restrictions for certain types of state and local obligations. General obligation bonds may continue to be issued on a tax-exempt basis by or on behalf of state or local governments to finance their traditional activities. No limits are imposed on the volume of these bonds that may be issued.

An obligation will be treated as a private-activity bond if it meets either the law's business use and security interest tests or the private-loan financing test:

- The business use rule provides that an obligation is generally a private-activity bond if more than 10 percent of the bond proceeds are used in a trade or business carried on by entities other than state or local governments. The security interest test provides that an obligation is generally a private-activity bond if more than 10 percent of the principal or interest is to be directly or indirectly repaid from or secured by revenues from a private trade or business. Under prior law, private participation under these tests had to exceed 25 percent to preclude governmental obligation financing.
- The private-loan financing test provides that an obligation will be a private-activity bond if the lesser of 5 percent of the bond proceeds or $5 million will be used to make loans to a nongovernmental person or entity.[38]

If state and local capital plans do not change, these tests will mean that an increased number of public works bonds will be issued as private-activity bonds, rather than governmental obligations as under prior law, subjecting them to the law's volume limitations.

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[35] U.S. House of Representatives, 99th Congress, Second Session, *Tax Reform Act of 1986, Conference Report to Accompany H.R. 3838*, Vol. II, Report 99-841, September 18, 1986, p. II-884.

[36] *Statistical Abstract*, op. cit., Table 443.

[37] Staff compilations based on Board of Governors of the Federal Reserve System, *Annual Statistical Digest* (Washington, DC: various years), and unpublished data from Dr. Ronald Forbes, State University of New York at Albany.

[38] The Joint Committee explanation of the law provides special treatment for bonds issued by tax or utility districts formed to provide public works services to new residential or office developments. During the development period, the land in such a district may be owned by a developer who is developing the land for sale to the public. Bond proceeds used to finance public works in such situations generally will not be treated as private-activity bonds simply by virtue of the fact that the developer owns the land at the time of the issue. Rather, the tax status of the bonds will depend on the ultimate use of the facilities. Thus, facilities that meet the test for governmental obligation bonds after the development period would be so treated even if the facilities did not meet the test at the time of issue.

Private-activity bonds to finance public works may still be issued on a tax-exempt basis if the facility falls into one of two exempt-facility categories. Bonds to finance airports, docks and wharves, and publicly owned solid waste disposal facilities may be issued without limit if they meet certain tests. Bonds to finance certain other types of projects are subject to annual volume caps based on the state's population. These projects include mass commuting, water, sewage, and certain types of hazardous waste facilities, and privately owned solid waste disposal facilities.

The 1987 ceiling for all allowable purposes was 113 percent of the 1984 level of borrowing for infrastructure within the Council's area of concern, but only 64 percent of the 1985 level and 56 percent of the 1986 level.[39] Further ceiling reductions scheduled for 1988 will exacerbate this effect.

It is too early to tell how these restrictions in the aggregate will affect the ability of state and local governments to finance infrastructure. Some projects could be downsized or foregone entirely, while others would be financed with more expensive taxable bonds or increased taxes and user fees. Still other projects may be restructured to allow general obligation financing.[40]

Any effects that do occur may not be felt for some years. Many governments borrowed more heavily than usual in 1985 and 1986, anticipating more restrictive tax legislation. These funds are available for ongoing and new projects. Heavy earlier borrowing partly accounts for the fact that the dollar volume of revenue and general obligation issues in 1987 was down almost one-third below the same period in 1986.[41]

The direct effects of the tax law's restrictions will largely be confined to the 40 percent of new annual infrastructure investment that is financed by bonds.[42] To the extent that the increased cost of borrowing exacerbates fiscal problems, however, all state and local government programs could be affected, regardless of their financing sources.

Eliminating Prior-law Investment Incentives

The tax code is now more neutral among alternative investments. The law contained the following changes:

- Repeal of the capital-gains and dividend exclusions for individuals.
- Limits on the deductibility of investment interest, passive losses, and individual retirement account contributions.
- Lengthened depreciation schedules for capital assets.
- Repeal of the investment tax credit.

These changes were intended to increase income and encourage more productive use of investment funds. The elimination of many prior-law investment incentives could benefit state and local governments by increasing investor demand for state and local securities. Interest on state and local general obligation securities remains tax-exempt. A Congressional Research Service study suggests that this tax benefit will increase demand among individual investors for state and local government securities. Increased demand, combined with a reduction in the volume of available securities, should reduce state and local governmental borrowing costs. At the same time, however, commercial banks are no longer a presence in the market for state and local government securities due to elimination of the deduction for the interest costs of holding state and local debt.

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[39] NCPWI calculations based on unpublished data provided to the Council by Dr. Ronald Forbes and Public Securities Association, *Report to Municipal Bond Issuers*, February 10, 1987. These figures are only approximations of the effect of the ceilings, since available data do not allow borrowing for publicly owned facilities to be distinguished from that for privately owned facilities where the law makes a distinction in treatment. Since the ceilings are applied on a state-by-state basis, the impact on individual states could be larger or smaller than these totals.

[40] It has been suggested that the tax law may raise the cost of capital to certain smaller issuers by forcing changes in the operation of bond banks. Bond banks are state agencies that issue bonds for capital projects on behalf of smaller governmental units. Under the new tax provisions, bond banks may no longer use arbitrage profits to pay for administrative costs. This change may not invalidate the usefulness of bond banks, however. Maryland has established a bond pool since the tax law went into effect. The costs of issuance will be prorated among the localities based on the amount borrowed, but will be absorbed by the state for the first two years.

[41] Public Securities Association, preliminary unpublished data, January 1988.

[42] National Council on Public Works Improvement, *The Nation's Public Works: Defining the Issues* (Washington, DC, September 1986), p. 65.

The elimination of prior-law investment incentives will change some of the options available to localities for financing public works projects.[43] In recent years, many state and local governments have involved private firms in the financing, design, construction, and operation of public facilities and services.

These arrangements brought tax benefits to the private firms and cost reductions to the governments. In particular, the Accelerated Cost Recovery System (ACRS), enacted in the Economic Recovery Tax Act of 1981 (P.L. 97-248), substantially reduced the period over which property could be depreciated for tax purposes. Municipalities claimed to have saved money because of private participation stimulated by the tax advantages to private developers.

Arrangements with the private sector sometimes offer potential advantages:

- *Maintenance.* State and local government fiscal pressures have contributed to undermaintenance. Private firms have an incentive to maintain facilities, since maintenance costs are operating expenses that are tax deductible.
- *Setting priorities.* Governments must weigh public works against other spending priorities. As a result, capital improvements and maintenance are often postponed in favor of operating expenses. Private firms, in contrast, have fewer competing responsibilities. This should encourage more efficient construction, maintenance, and operating decisions.
- *Performance sanctions.* Private firms can lose contracts or profitability for inadequate performance. Equivalent sanctions generally do not exist for public agencies.

Potential disadvantages of privatization include the possibility that private firms will "skim" the more profitable public-sector functions that could, if maintained as public functions, generate a surplus to help finance deficit-producing activities.

In a recent survey of city and county governments, about one-third of the officials responding reported having contracted for services from the private sector.[44] Reasons for doing this included capital-cost savings and lack of needed expertise in the municipality.

Nearly 40 percent of the survey respondents plan to privatize facilities in the next two years, even though the elimination of many prior-law investment incentives reduced the savings localities will realize. The survey respondents plan to privatize an estimated $3 billion worth of facilities over the next two years.[45]

In sum, the Tax Reform Act of 1986 is likely to increase the cost of providing public works through public-private partnerships. This will discourage some projects, reduce the size of others, and move still others entirely into the public sector. For some localities, however, the advantages of privatization still remain.

RESTRICTIONS ON STATE AND LOCAL INFRASTRUCTURE FINANCE[46]

Federal tax policy sets limits on the ability of state and local governments to issue tax-exempt obligations. State constitutions and statutes further limit state and local capacity to finance public works. States limit state and local spending, taxing, and borrowing powers; prescribe interest rate limits and referenda requirements; and impose conditions on privatization.

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[43] For a more detailed discussion of private [illegible] Touche Ross [illegible] "Impact of the Tax Reform Act of 1986 on Privatization," [illegible] Public Works Improvement, [illegible] John E. Petersen, et al., "Constitutional, Statutory and Other Impediments to Local Government Infrastructure Financing," [illegible] National Council on Public Works Improvement, October 1987; and [illegible] Impact of the Tax Reform Act of 1986 [illegible] New York, March 1987.

[44] Touche Ross & Co., "Privatization in America: An Opinion Survey of City and County Governments on Their Use of Privatization and Their Infrastructure Needs," Washington, DC, 1987. The survey was mailed to 5,718 governments; 1,086 responded.

[45] Extrapolating these sample results to the universe of governments surveyed suggests that cities and counties could privatize as much as $16 billion in new facilities over the next two years. This would be equivalent to just over one-sixth of all local capital spending in 1985 and would suggest that privatization will be a major public works financing trend. However, such an extrapolation could generate an estimate that is too high. The respondents were self-selected and those officials who chose to respond could have had a higher interest in privatization than those who did not.

[46] For a more detailed discussion, see John Petersen, et al., "Constitutional, Statutory and Other Impediments to Local Government Infrastructure Financing," prepared for the National Council on Public Works Improvement, October 1987.

State Tax and Spending Limits

State limits on revenues and expenditures that affect public works financing fall into three categories: restrictions on local property taxes, limits on local revenue collection, and limits on local government spending.

Property tax restrictions. Accounting for 74 percent of local government tax revenue in 1985, the property tax is the largest revenue source for local governments. Rapidly increasing property taxes led to taxpayer revolts in the 1970s and early 1980s, and resulted in the passage of laws to limit the use of property taxes.

States use three methods to directly restrict local governments' ability to raise revenue from property taxes: property tax rate limits, limits on the property tax levy, and limits on the amount that property assessments can increase annually. Some such limits are written into local charters.

As of October 1985, 31 states had imposed specific property tax rate limits on local governments. Where property is increasing in value, such limits may not halt growth in property tax revenues. Combined with limits on increases on the assessed value of property, however, property tax rate limits can have a substantial impact. As of October 1985, 22 states imposed limits on the assessed value of property. Seven states set limits on the annual increase in assessed valuation. States may also control local property tax revenues by placing a limit on the assessment ratio, which is the percentage of a property's full market value subject to taxation.

While the short-term effects of restricting property tax revenues to local governments are substantial, the long-term implications of such limits are unclear. Some local governments turn to other revenue sources, such as user fees or increased use of state funds. Others reduce budgets and levels of service, which may increase fiscal pressure on state governments. Tax limits also have a negative effect on a locality's credit standing and may increase the cost of its debt.

State restrictions on local revenues. As of 1985, six states set either constitutional or statutory limits on the total amount of revenues local governments could collect annually. Such limits hinder the ability of local governments to deliver services and adversely affect credit ratings.

Spending restrictions. Limits on the amounts that a local government can appropriate or spend in a given year may be expressed as an allowable percentage increase or as an absolute dollar amount. Six states imposed such limits on local governments as of October 1985.

At least 20 state governments have revenue and expenditure restrictions. Such limits often tie increases in revenues or expenditures to growth in the state's economy, growth in total state personal income, or to a specific percentage. As with local governments, such restrictions limit revenues collected from various tax and user charges and curb their ability to deliver services; they also may affect state credit ratings.

Debt Limits

Traditional general obligation bonds and project-specific revenue bonds are the two debt financing mechanisms that local governments have at their disposal. Revenue bonds are typically regulated at the state level by placing a cap on debt levels through state-mandated debt limits or referenda requirements.

Municipalities in 44 states face constitutional or statutory limits on the amount of general obligation debt they can incur; two other states impose specific indirect limits. Such limits, related to some percentage of a municipality's real property, are designed to cap local indebtedness.

In reality, such limits often have little impact since municipalities maintain indebtedness levels far below the cap. In 1981, for example, a study prepared for the New York State Assembly showed that over 75 percent of the nation's cities used less than 40 percent of the general obligation debt capacity and 97 percent of smaller towns use less than 20 percent of their legal capacity. The study demonstrated that since 1975, the amount of debt margin of general obligation debt used by New York local governments has seen a downward trend, partly due to a shift of debt to revenue bonds.[47]

These findings are reinforced by the results of a 1986 national survey that found that only 3.8 percent of local officials considered debt limits to be the major constraint on borrowing.[48] Local officials report that other considerations, including taxpayer disapproval and the adverse effect of higher taxes on economic growth, are more important in limiting the amount of debt issued.

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[47] New York State Legislative Commission on State-Local Relations, *New York's Limits on Local Taxing And Borrowing—a Time for Change?* (Albany, 1983), p. 11.

Interest Rate Limits

States also use statutory interest rate limits, procurement or bidding requirements, and referenda requirements to curb municipal general obligation borrowing. The relevance of such controls is often questionable, due to the states' willingness to adjust limits as needed. Although every state has statutory language designed to ensure the most favorable interest rates to municipalities on the issuance of bonds, such regulations are often unclear or contradictory.

Referenda Requirements

Some form of voter approval of general obligation bond issues is required in 42 states. While a majority of local officials believe they need more capital expenditures for public works, 35.9 percent of local officials questioned in a recent survey listed referenda requirements as the major impediment to indebtedness.[49] Municipalities have, however, found several other ways to issue debt without voter approval. These include the following:

- Allowing general obligation debt issues of certain sizes without referenda.
- Issuing revenue bonds for activities previously financed by general obligation bonds.
- Shifting the cost of capital construction forward to developers while rebating the cost through tax incentives or abatements.

Limits on Public-Private Partnerships

Many states have explicit constitutional statutory provisions governing private development of capital-intensive public services. Twenty-eight states permit private solid waste collection and disposal, and 24 states permit private sewer and water facilities.[50] In addition, some municipalities may be able to privatize services under their home rule power even if this is not explicitly permitted by state law.

Intergovernmental Tax Comity

Some groups at the state and local level have expressed concern about potential encroachment of the federal (or state) government on state and local tax bases. The concern is that the use of certain taxing techniques at the federal (or state) level could restrict state and local government finance capacity. However, federal use of a tax base need not bar its use at other levels of government; income, for example, is commonly taxed at all levels of government. In some cases, however, federal use of a tax base may make state and local taxation of that base more difficult. For example, the multiple use of certain excise taxes (e.g. gas or beverage taxes) may increase prices of goods and services so much that actual tax receipts could decline if each level of government acted independently.

There is a need for more information on the effect of taxes at the federal (or state) level on the effective tax capacity and spending levels of state and local governments. Some evidence exists that federal abandonment of certain tax bases might not result in more state and local spending. For example, in a recent survey, the ACIR asked local government officials what they thought their state would do if federally aided highway programs and revenue bases were transferred to the states.[51] Over half the officials surveyed thought spending in their state would increase, but nearly 20 percent thought it would decline.[52]

Local governments, the primary provider of most public works, are taking an increasing share of financing those public works as well. In this environment, the Council believes more attention should be paid to the effect of federal and state tax increases and initiatives on the capacity of other levels of government to finance their infrastructure investment, operation and maintenance.

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[48] Michael A. Pagano, "How the Public Works: Major Issues in Infrastructure Finance," (Washington, DC: The National League of Cities, September 1986), pp. 15-18.

[49] Ibid., pp. 15-16.

[50] Petersen, et al., "Constitutional, Statutory and Other Impediments to Local Government Infrastructure Financing," op. cit., p. 45.

[51] John Kincaid and Max B. Sawicky, *Local Perspectives on State-Local Highway Consultation and Cooperation: Survey Responses From State Associations of Local Officials* (Washington, DC: July 1987).

[52] NCPWI calculations based on ACIR, ibid., Table 13.

State and Federal Restrictions in the Context of a National Strategy

State and local spending, taxing, and borrowing restrictions are numerous and complex; they stem from the unique historical, constitutional, and political framework of each state. The effects of these restrictions are also complex; they may affect political structures, spending priorities, and accountability (see "Special Districts and Authorities," above, for further discussion). Such restrictions may increase the cost of financing infrastructure and reduce public works spending. As all levels of government work toward a reinvestment strategy for the nation's infrastructure, unduly restrictive fiscal limitations must be reassessed.

CONCLUSIONS AND POLICY OPTIONS

Infrastructure finance policy debates revolve around three questions:

- How much should we spend?
- Who should pay?
- How should spending be financed?

The answers to these questions are interdependent. How much to spend depends on who will pay and how the charges will be collected. The financing method chosen, in turn, will determine whether the revenues are adequate and reliable.

Implementing the Benefit Principle in Public Works Finance

Public works services should be priced so that direct users, indirect beneficiaries, and producers of wastes pay the costs of services. If prices reflect costs, the public's use of a facility and its willingness to pay for services will indicate the appropriate scale and distribution of public works. Using such an approach will be easier with better information about the relationship between use patterns and charges. More sophisticated pricing techniques can then be developed. Nevertheless, general-fund subsidies will still be necessary to promote society's interest in the quality of services and to retain fair and affordable distribution of services.

Reliable Revenue Streams for Public Works Finance

The various dedicated financing techniques examined in Council research can improve public works management. Public works lend themselves particularly well to dedicated financing techniques because of their long lives, need for continued maintenance, and the unevenness of their replacement and rehabilitation expenditures. In addition, a clear benefit-cost connection often promotes easier acceptance of new spending programs by voters and legislatures. Making this connection clear could become particularly important for financing new needs such as hazardous waste disposal. Few institutional structures currently cover this problem.

However, these techniques are not foolproof. At all levels, the political process responds to changing public priorities regardless of institutional rigidities and constraints. Legislatures can fail to appropriate already collected trust-fund balances; earmarked revenues can be offset by reduced general-fund spending; and special districts can fail to carry out their mission because of their financial dependence on general-purpose governments.

Most important, perhaps, Council research suggests that sound public-sector fiscal policy and a strong economy are crucial to good public works programs. Where these are present, institutional arrangements to protect public works are less significant. In the absence of sound fiscal policy and a strong economy, public works programs will not succeed.

CHAPTER IV

GOVERNMENTAL AND PRIVATE ROLES IN PUBLIC WORKS

Public works, though largely local, have more than local significance. Intergovernmental regulation and shared financing have become important, even though direct state and federal roles in owning, operating, and maintaining public works are relatively limited. For example, although federal and state governments play an important role in highway programs, there is no federal ownership of roads except on federal lands; moreover, states own only about 24 percent of all mileage.

Exhibit IV-1 shows the relative roles of the three levels of government in financing operations, maintenance, and capital expenditures for seven types of public works (for which consistent data are available). The striking patterns are the heavy concentration of federal financing in the capital sector, the general dominance of local financing for operations and maintenance, and the relatively small state financing role. (The state is important in highways and in some aspects of water projects.)

Because of the complexity of these interrelationships, accountability for programs is often difficult to trace. This chapter examines the existing roles in major public works categories, some recent shifts, and proposals for changes designed to help clarify responsibilities.

Examining public works roles means looking at many actors and a wide range of tasks. The actors include the three levels of government (federal, state, and local), special- and general-purpose units of government, and private firms. The principal tasks include the following:

- Establishing general program goals, policies and strategic plans.
- Regulating facilities and services.
- Planning, building, owning, operating, and maintaining specific facilities (projects).
- Financing capital improvements, operations, and maintenance.
- Researching and demonstrating new technologies and techniques.
- Providing technical assistance and promoting innovation.

SUMMARY OF LEAD ROLES[1]

Federal

The federal government plays the dominant role in planning, setting standards for, and providing capital financing of the Federal Aid Highway System; in operating and maintaining the nation's airways, harbors, and major dams; and in cleaning up major hazardous waste sites. It also takes the lead in capital financing of mass transit and many smaller airports; in standard-setting for urban water supply, wastewater treatment, and hazardous waste; and in capital financing for wastewater treatment. The last role is changing; state revolving loan funds will be capitalized under current legislation phasing out federal funding for wastewater treatment facilities. Federal construction grants are scheduled to cease in 1990, although federal capitalization of state loan funds is authorized through 1994. (See Exhibit IV-2.)

State

States play dominant roles only in noninterstate federal-aid highways and nonfederal dam safety programs (see Exhibit IV-2). Although the states own, operate, and maintain most of the federal-aid highways (both interstate and noninterstate) as well as some other highways—that mileage accounts for less than one-quarter of all roads. The states' dominance in federally aided noninterstate highways (supported significantly by the state gasoline tax) is eclipsed in most states by the much greater mileage of local road systems. The major exceptions are Alaska, West Virginia, Delaware, Virginia, and North Carolina, where state ownership accounts for 85 percent or more of the total road mileage in the

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[1] For a more detailed discussion of issues raised in this section see Wm. G. Colman, "Provision for the Major Categories of Physical Infrastructure: The Question of Proper Roles," prepared for the National Council on Public Works Improvement, August 6, 1987.

EXHIBIT IV-1

GOVERNMENT OUTLAYS FOR PUBLIC WORKS IN 1984, $97.7 BILLION

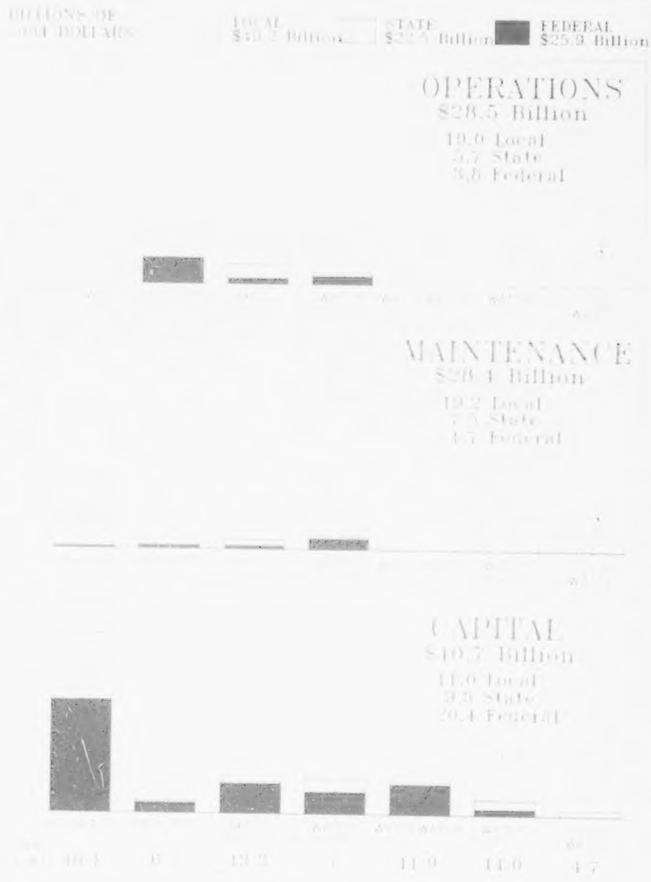

EXHIBIT IV-2
USUAL LEAD ROLES IN PUBLIC WORKS CATEGORIES*

Categories of Public Works	Program Tasks: Policy & Standard Setting	Program Tasks: Capital Financing	Program Tasks: Ownership, Operations & O/M Financing
Highways:			
interstate	F	F	S
noninterstate	S/L	S/L/PS	S/L
Airports:			
major commercial	L	L/PS	L/PS
general aviation and smaller commercial	L	F	L/PS
Airways	F	F	F
Mass transit	L	F	L/PS
Water supply (urban)	F/S	L/PS	L/PS
Wastewater treatment	F	F/S	L
Water resources			
ports (landside)	L	L/PS	L/PS
dredging/navigation	F	F	F
major dams	F	F	F
urban stormwater	L	L	L
nonfederal dam safety	S	PS/L	PS/L
Solid waste	S/L	L/PS	L/PS
Hazardous waste			
currently generated	F/S	PS	PS
site cleanup	F	F	PS

LEGEND: F = Federal, S = State, L = Local, PS = Private Sector

*Because of the great variety in the American federal system, there are exceptions to these lead roles. For example, the Baltimore-Washington International Airport is owned and operated by the state of Maryland, and ports are owned and operated by the states of Alabama, Georgia, and Virginia.

SOURCE: Council staff. Based on Wm. G. Colman, *Provision for the Major Categories of Physical Infrastructure: The Question of Proper Roles*, prepared for the National Council on Public Works Improvement, August 6, 1987; also based on the nine studies of individual public works categories prepared for the Council in May 1987.

state. On average, states own 24 percent of all roadways and spend approximately 80 percent of all their infrastructure monies on them.

There is an increasing state role in public transportation, with states like Maryland, Virginia, New Jersey and New York actually operating mass transit facilities. Overall, data collected by American Association of State Highway and Transportation Officials (AASHTO) show that in 1987 total state contributions (capital and operating) to mass transit exceeded the federal government's contributions, and the gap will widen in fiscal year 1988 under the federal budget approved in December 1987.

The state role in water supply regulation is now shared with the federal government. This resulted from rising national environmental concerns which led to new drinking water standards. Similarly, federal standards drive the states' regulatory role in managing currently generated hazardous waste. Their solid waste regulatory roles are shared with localities. The now-emerging strong state role in financing wastewater treatment plants results from a federal transfer of responsibility.

Local

Local governments generally dominate the provision of local roads (accounting for 76 percent of all roads), mass transit, airports, certain landside facilities at water ports, water supply, urban stormwater facilities, and solid waste disposal (see Exhibit IV-2). Exceptions include the use of special districts in many areas (as noted below), the provision of local roads by a few states, and federal dominance in the capital financing of transit. In addition, key local roles are often shared with the private sector. This includes an important private role in funding, operating, and in some cases owning airports, water ports, water supply, solid waste disposal facilities, and nonfederal dams.

Special Districts and Authorities[2]

Independent special districts and authorities provide some public works in all states except Arkansas and Hawaii.[3] Some of these units are agents of the states, while others are agents of individual localities or regional groups of jurisdictions. They provide airports, highways, mass transit, water transport, sanitation, sewerage, water supply, and natural resources facilities. More states were using special units in 1982 than in 1972 for all these categories of public works. However, fewer than half the states use special units for highways, water transport, and sanitation (see Exhibit IV-3). The most frequently used district is for natural resources (43 states).

Even among states that use independent special districts and authorities, such units spend an average of more than half of the capital used at the state and local levels in only two functions: transit and water transport (see Exhibit IV-4). However, individual states vary greatly. The proportion of capital outlays spent in any given state by such units ranges from 0.1 to 100 percent of all the state and local capital spending for the designated functions (see Exhibit IV-5).

These statistics understate the role of districts in providing public works; they do not count "subordinate" units classified by the U.S. Census as being under the control of general-purpose governments. According to one estimate, the bonded indebtedness of these subordinate districts equals 62 percent of that of the independent ones.[4]

Private Sector

The private sector plays several key roles in providing public works services (see Exhibit IV-2). The most prominent is in hazardous waste management. Virtually all hazardous waste disposal facilities outside of federal installations are privately owned and operated. In addition, development of waste-to-energy technology has been primarily undertaken by the private sector, and these facilities are often operated by private firms.

Resource recovery projects have lent themselves particularly well to private-sector involvement. An estimated 70 projects have been developed under contracts with private firms.[5] These projects posed new technical risks. They were also more capital-intensive than landfills, the major solid-waste disposal alternative, making the developer's equity investment an attractive cost reduction to municipalities.

The private sector also owns and operates about one-quarter of all water supply systems, serving some 16 percent of the U.S. population. About two-thirds of all solid waste management expenditures are made by private firms. Of the nation's 5,900 airports open to the public, three-fourths are privately owned and operated, although they handle less than one-half of one percent of all air passengers. Even the operation of some low-activity airspace control towers has been contracted to private firms. In addition, the private sector owns and operates approximately three-quarters of all nonfederal dams. Private companies fund and operate some terminal facilities at water ports and airports. Finally, a 1985 survey of more than 1,000 public transit agencies showed that nearly 35 percent of them contracted with private firms for some or all of their services (amounting to about nine percent of the total service provided).[6]

Developers usually build local roads, sewers, water lines, and storm drainage facilities on sites they develop. They then turn the facilities over to the public for operation and maintenance. Increasingly, they build and dedicate to the public, or help to finance, facilities serving more than their own developments. Many court tests have upheld requirements for developers to contribute financially toward such larger facilities in proportion to the need created by their new developments.

Logging companies often build roads on forest service lands to access timber contracted for sale. In fiscal year 1983, for example, they built almost 6,000 miles of such roads at a cost of $130 million.

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[2] For a more thorough discussion of special districts and authorities, see Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provision," prepared for the National Council on Public Works Improvement, August 1987, as well as [illegible]

[3] A very large number of "dependent" special districts also play important public works roles, but they are classified by the U.S. Census Bureau as parts of their host governments (state or local) and are not included in the Census of Governments reports upon which this discussion is based.

[4] Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provision," a report to the National Council on Public Works Improvement, August 1987. Even this estimate is an understatement because it is [illegible]

[5] Scully Capital Services, "Impact of the Tax Reform Act of 1986 on Privatization," prepared for the National Council on Public Works Improvement, June 26, 1987.

[6] R.F. Teal, "Transit Service Contracting: Experience and Issues," *Transportation Research Record 1036* (Washington, DC: Transportation Research Board, 1985), pp. 28-36.

EXHIBIT IV - 3

NUMBER OF STATES USING INDEPENDENT SPECIAL DISTRICTS FOR CAPITAL SPENDING ON PUBLIC WORKS BY CATEGORY

	Year		
Category of Public Works	1972	1977	1982
Highways	10	12	15
Airports	22	27	27
Mass transit	11	19	29
Water supply	38	35	40
Water transport	12	13	14
Sewerage	37	33	39
Sanitation (other than sewerage)	7	6	18
Natural resources	40	35	43
All Categories	48*	48*	48*

*Only Arkansas and Hawaii do not have independent special districts and authorities for public works.

SOURCE: [illegible] "The Role of Special Districts and Public Authorities in Public Works Provision," prepared for the National Council on Public Works Improvement, August 1987.

EXHIBIT IV - 4

AVERAGE PERCENTAGE OF ALL STATE AND LOCAL CAPITAL SPENDING IN A STATE MADE BY INDEPENDENT SPECIAL DISTRICTS, BY CATEGORY

	Year		
Category of Public Works	1972	1977	1982
Highways	[illegible]	1.7	1.9
Airports	[illegible]	25.4	28.5
Mass transit	[illegible]	63.7	70.2
Water supply	[illegible]	21.3	23.1
Water transport	[illegible]	55.4	58.0
Sewerage	[illegible]	25.4	19.6
Sanitation (other than sewerage)	[illegible]	12.7	11.0
Natural resources	[illegible]	11.8	17.0

SOURCE: [illegible] "The Role of Special Districts and Public Authorities in Public Works Provision," prepared for the National Council on Public Works Improvement, August 1987.

EXHIBIT IV-5

RANGE OF CAPITAL SPENDING
BY INDEPENDENT SPECIAL DISTRICTS
AS PERCENTAGE OF ALL STATE AND LOCAL
CAPITAL SPENDING BY CATEGORY

	Year		
Category of Public Works	1972	1977	1982
Highways	0.1- 11.1	0.1- 6.1	0.1- 13.0
Airports	1.0- 99.0	0.3- 75.4	0.1- 91.3
Mass transit	14.1-100.0	0.1-100.0	0.7-100.0
Water supply	0.1- 92.9	0.1- 96.5	0.2- 63.6
Water transport	11.1-100.0	15.7-100.0	2.8-100.0
Sewerage	0.2- 81.7	0.1- 79.3	0.1- 79.4
Sanitation (other than sewerage)	1.7- 76.8	0.1- 28.7	0.1- 65.8
Natural resources	0.1- 75.6	0.1- 53.6	0.1- 51.4

SOURCE: U.S. Census of Governments, as reported to the National Council on Public Works Improvement by the Institute of Public Administration.

Finally, private companies under contract to public agencies design and build almost all public works and provide some maintenance service.

CHANGING PUBLIC WORKS ROLES

Public works roles are constantly changing, especially in recent decades. The federal government expanded its role in domestic programs on many fronts over the period from the Great Depression until the late 1970s. In this expansion, the federal government embarked on a significant series of new building programs. These programs were designed to accomplish the following:

- Tie the nation together by a safe, high-speed interstate freeway system.
- Develop a system of air travel to reduce transcontinental travel time.
- Rebuild America's decaying central cities.
- Retain affordable mass transportation (previously provided privately) to help automobile congestion and promote central city economic vitality.
- Provide decent, safe, and sanitary housing.
- Clean and protect the environment.

In the late 1970s, a reevaluation of the federal role began as federal fiscal strength started to falter. At the same time, critics contended that federal rules and regulations stifled creativity and cost-effectiveness in meeting state and local needs.[7]

By the end of the Carter Administration, the President's Commission on a National Agenda for the Eighties recommended shifting national urban policy away from place-oriented physical and economic development programs to people-oriented, place-neutral programs. A few years later, the Committee on Federalism and National Purpose (the Evans-Robb Committee) made a similar recommendation.

Since 1981, federal income tax rates have been reduced and federal spending priorities have shifted toward defense, the social safety net, and interest on the national debt. The unprecedented rise of the peacetime federal deficit in the 1980s has forced reconsideration and redesign of many federal-aid programs, including many in public works, and has initiated searches for other sources of infrastructure funds.

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[7] See, for example, Advisory Commission on Intergovernmental Relations, *An Agenda for American Federalism: Restoring Confidence and Competence* (Washington, DC, 1981) and Advisory Commission on Intergovernmental Relations, *Regulatory Federalism: Policy, Process, Impact and Reform* (Washington, DC, 1984). See also, U.S. Office of Management and Budget, *Managing Federal Assistance in the 1980s* (Washington, DC, March 1980).

Recent tax law changes have rescinded investment incentives enacted in 1981 that encouraged greater private sector participation in providing public works. The municipal bond market is now sorting out the effects of these new provisions.

These trends establish a context in which to consider both public works spending and performance as well as proposals to change the responsibilities of those who provide services.

Criteria for Evaluating Public Works Roles[8]

Concern over the growth in federal domestic programs following World War II spurred interest in sorting out the proper roles of the federal and state governments. Many studies have been concerned with defining appropriate federal roles, returning certain established federal roles to states and localities, and selecting appropriate tools for implementing intergovernmental policies.[9] The principles and criteria developed in those studies are briefly summarized here to help guide the succeeding review of proposals for modifying current public works roles and responsibilities.

Principles for defining the federal role. In 1955, the Kestnbaum Commission[10] set forth two sets of principles for defining the federal government's role, one set to limit the definition of national purpose, and another to limit federal restrictions on state action.

In the Commission's view, the federal government should be involved in a program only if the following hold true:

- The activity considered is clearly national in scope with a constitutional basis.
- The federal government is the only one that can summon the resources needed.
- The activity cannot be handled within the geographic and jurisdictional limits of states or by interstate compact.
- The activity requires a nationwide uniformity of policy that cannot be achieved by interstate action.
- A state, through action or inaction, does injury to the people of another state.
- A state fails to respect or to protect basic political and civil rights that apply throughout the nation.

The Kestnbaum Commission's recommended limits to federal restrictions on state action were as follows:

- The national government need not legislate on a given matter in a field of concurrent power for a state to take action on the same subject.
- National laws should be so framed that they will not be construed to preempt any field against state action unless this intent is stated.
- Exercise of national power on any subject should not bar state action on the same subject unless there is positive inconsistency.
- When a national minimum standard is imposed in a field where uniformity is not imperative, the right of states to set more rigorous standards should be carefully preserved.
- Statutes should provide flexible scope for administrative sessions of jurisdiction where the objectives of the laws at the two levels are substantially in accord. State legislation need not be identical with the national legislation.

As Woodrow Wilson wrote, each generation must seek its own definition of national purpose and proper balance among the levels of government.[11] It is not surprising, then, that additional principles have developed since the Kestnbaum report. The Congressional

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[8] For a more detailed discussion, see Wm. G. Colman, "Provision for the Major Categories of Physical Infrastructure: The Question of Proper Roles," prepared for the National Council on Public Works Improvement, August 6, 1987.

[9] Such studies include: The Commission on Intergovernmental Relations, *A Report to the President for Transmittal to the Congress* (Washington, DC, June 1955); The Advisory Commission on Intergovernmental Relations, *The Federal Role in the Federal System: The Dynamics of Growth. An Agenda for American Federalism: Restoring Confidence and Competence* (Washington, DC, June 1981), Report A-86; The Advisory Commission on Intergovernmental Relations, *Governmental Functions and Processes: Local and Areawide* (Washington, DC, February 1984), Vol. IV, Report A-45; Committee on Federalism and National Purpose, *To Form a More Perfect Union*, December 1985; Congressional Budget Office, *The Federal Government in a Federal System: Current Intergovernmental Programs and Options for Change* (Washington, DC, August 1983); and Congressional Budget Office, *Public Works Infrastructure: Policy Considerations for the 1980's* (Washington, DC, April 1983).

[10] The Commission on Intergovernmental Relations, *A Report to the President for Transmittal to the Congress* (Washington, DC: U.S. Government Printing Office, June 1955), pp. 62-72.

[11] Woodrow Wilson, *Constitutional Government in the United States* (New York: Columbia University Press, 1917), p. 173.

Budget Office, for example, has recommended that the federal government should have a role under the following conditions:

- External effects (especially negative ones) spill across state borders (this expands Kestnbaum's "state injury" principle).
- Marked improvement in efficiency or effectiveness can be gained from centralized coordination that only the federal government can supply.
- A crisis or special need of some sort—either natural, social, or economic—befalls a particular group or geographic region.[12]

Two other recent reports have continued the debate.[13] The first, known as the Evans-Robb Report, largely reaffirmed the Kestnbaum principles for limiting the federal role to programs needing nationwide uniformity or nationwide financing, and reserving to states and localities programs in which diversity and experimentation responsive to local electorates are important. Applying this standard led to the conclusion that the federal government should be responsible for income redistribution and support programs, and localities should be responsible for other programs, including public works.

In addition, the Evans-Robb Report stressed the federal responsibility to help states with very low fiscal capacity through general-support grants. The Evans-Robb Report also stepped beyond the federal-state allocation issue to suggest that states should be responsible, as distinguished from localities, when local government boundaries create barriers to effectively raising revenues and delivering services, and when resources and responsibilities must be distributed among localities.

The other recent report is a Reagan Administration formal statement of federalism principles.[14] It emphasized "strict adherence to constitutional principles" in limiting the federal role and allowing maximum discretion to the states. Even when uniform nationwide standards are needed, the stated preference would be for uniform state legislation rather than national legislation, or consultation with the states in formulating federal standards. The report reaffirmed the general principles of the Kestnbaum report, but endorsed a different implementation strategy than the Evans-Robb report.

Criteria for readjusting federal and state responsibilities. It is one thing to decide whether the federal government should take on a new responsibility, and quite another to shift existing responsibilities from the federal to the state and local levels. Some supplemental criteria may help evaluate and mitigate the practical difficulties involved.

The Advisory Commission on Intergovernmental Relations (ACIR) recommended that the primary candidates for termination and phase-out at the federal level include the following:[15]

- Categorical grant programs that are too small to have much impact or to be worth the cost of administration.
- Programs that do not embody essential and clear national objectives.
- Programs that get (or could get) most of their funding from state and local governments, or from fees for services, or that could be shifted to the private sector.

ACIR also recommended that in shifting responsibilities, the following be considered:[16]

- The extent of the decentralization.
- The simplicity of the plan.
- The certainty of funding.
- The adequacy of future revenues.
- The effects on fiscal discipline.

Many devolution proposals provide transition devices to avoid sudden fiscal and administrative shocks; many devolutions would require state legislative action and other time-consuming and politically difficult adjustments. ACIR reports and the Evans-Robb Report support this approach.

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[12] Congressional Budget Office, *The Federal Government in a Federal System: Current Intergovernmental Programs and Options for Change*, op.cit.

[13] Daniel J. Evans and Charles S. Robb, Chairmen, *To Form a More Perfect Union* (Washington, DC: National Conference on Social Welfare, December 1985); The White House Working Group on Federalism of the Domestic Policy Council, "The Status of Federalism in America" (Washington, DC, November 1986).

[14] Executive Order 12612, October 26, 1987.

[15] Advisory Commission on Intergovernmental Relations, *An Agenda for American Federalism: Restoring Confidence and Competence* (Washington, DC: U.S. Government Printing Office, June 1981), Report A-86.

[16] Advisory Commission on Intergovernmental Relations, *Devolving Federal Program Responsibilities and Revenue Sources to State and Local Governments* (Washington, DC, March 1986), Report A-104.

Appropriate mechanisms for implementing shared responsibilities. Despite the extensive attention given to criteria for sorting out responsibilities and devolving federal programs, intergovernmental sharing of responsibilities remains the most common approach. The federal government has devised several mechanisms for implementing public works policies cooperatively with state and local governments including:

- Categorical grants (including formula, project, and open-ended grants).
- Block grants.
- General revenue sharing.
- Cooperative agreements.
- Contracts.
- Loans.
- Loan guarantees.
- Tax expenditures.
- Regulations.

All of these are currently used in public works except general revenue sharing and open-ended categorical grants.[17] Each has distinct characteristics for sharing, rather than separating responsibilities, but actual programs frequently are hybrids.

States have a parallel set of tools for sharing responsibilities with local governments. The primary difference is that states use a form of revenue sharing that returns state-collected receipts directly to the jurisdictions in which they were generated, usually for a designated purpose. The other important difference is that states collect local-option taxes piggybacked on state income, sales, or gasoline taxes. The collected receipts are returned to their original jurisdiction.

This section briefly describes the basic intergovernmental policy implementation mechanisms.

Categorical grants. Categorical grants are designed to stimulate new or increased activity that generates additional spending of recipients' own funds.[18] Categorical grants usually require matching funds and often require that the recipient not reduce current spending. The activities supported may be narrowly defined; performance requirements may be specified. A detailed application is required for specific projects designed to be completed within a certain time; recipients must prepare and submit progress reports and a final project-completion report.

Categorical grants are allocated on either a case-by-case project basis such as the mass transit capital grant or by a formula based on relative program needs among recipients such as the federal-aid highway grants. Open-ended categorical grants reimburse program costs for the case loads handled; welfare programs are an example. Often there is competition for project grants. In such cases, grant administrators exercise considerable discretion in funding.

Categorical grants stimulate new and expanded activities and build program performance capacity. Their principal drawbacks lie in their administrative complexity and their lack of flexibility.

Block grants. Block grants support much broader programs than categorical grants, leaving recipients more discretion about funding and performing activities. The community development block grant is an example; it consolidated programs for urban renewal, open space, water and sewer facilities, and community facilities. Block grant funds are allocated among all eligible recipients by a formula based on relative measures of program need. Matching funds may not be required.

Although block grants generally are designed to support established programs rather than to stimulate additional spending by recipients, maintenance of effort is likely to be required, and some stimulative effects have been noted.[19] These effects are generally less pronounced than for categorical grants.

Application requirements may be minimal. The administrative burden is substantially less than for categorical programs; simplicity and flexibility are key features of block grants.

Block grants frequently result when pre-existing categorical grants are consolidated. It is easiest and most appropriate to consolidate closely related programs having similar recipients.

General revenue sharing. The federal government's general revenue sharing program distributed funds to the 50 states by formula from 1972 to 1980 and to approximately 34,000 counties, cities, towns, and townships from 1972 to 1986. The program provided general financial support with few programmatic limitations. Some of the funds went for public works capital improvements at the recipients' discretion, but there was great variation from place to place. The program had only a modest effect in equalizing state and local fiscal capacities. It was the most far-reaching form of federal aid to local governments because of its broad eligibility and lack of application requirements. Indeed, for many small local governments it was the only federal aid ever received.

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[17] The Aid to Families and Dependent Children (AFDC) welfare program is an example of an open-ended categorical grant outside the public works field.

[18] The extent of increased commitment by recipients to use more of their own funds for the aided purpose has varied from year to year. Generally, however, the stimulative impact has declined over the past 20 years. Nevertheless, when federal grant funds have been cut, local governments frequently have sought to replace at least some of the lost funds through such means as increased spending of their own funds, substitution of user fees, or private sector investments. See National Council on Public Works Improvement staff paper, "Alternative Ways to Stimulate Public Works Spending," October 1987.

[19] Ibid., p.6.

This form of aid is not designed to increase spending of recipients' own funds. About one-half the funds, in fact, have been substituted for recipients' own funds, offering a measure of fiscal relief, rather than stimulation.[20]

Cooperative agreements. These are used in lieu of grant contracts when neither the federal government nor the recipient can specify the division of project responsibilities ahead of time. The agreement is tailored to the project through negotiation, both parties share management responsibilities. Funding may or may not be shared. Cooperative agreements have been used for water resources projects, rural development, and research or demonstration projects.

Contracts. In a contract, the federal government develops the specifications for the project, supplies all the funding, and takes delivery of a product or service before paying. The role of the state or local government entering into a contract is to perform the specified work without discretion (as though it were a private contractor). An example would be local provision of utilities to a federal installation.

Loans and loan guarantees. Direct federal loans provide capital at low interest rates for some public works programs. By putting greater financial responsibility on recipients, loans do not create incentives to overinvest as some grants have done. Loans can be targeted to particular types of public works, distressed areas, or innovative technologies, and they can carry a wide variety of technical, managerial, and policy conditions similar to those associated with categorical grants. Direct loans, however, are limited to the amount capitalized by public funds.

Federal-loan guarantees back private lending for some public works. The effect is to expand public access to the private capital market at favorable interest rates.

Federal tax expenditures. By providing or withdrawing special exclusions, exemptions, and deductions in the Internal Revenue Code, the federal government raises or lowers incentives for the private capital market to invest in favored sectors, including public works. The capital markets provide significant portions of the funding for many public works, especially those financed by user fees. Adjustments in market incentives can significantly affect the cost of borrowing for public works and the extent of private equity participation. Thus, federal tax policy directly affects the cost of financing public works.

Regulations. The federal government regulates public works through its independent national powers (such as interstate commerce) and through conditional federal aid.

Summary. These various methods are alternatives to each other in a very real sense; there is a continuing shift back and forth as the nature of shared responsibilites changes. For example, the end of general revenue sharing signaled a need to consider shifts in the use of other programs.

Choosing among the mechanisms means identifying the policy objective and weighing the strengths of each; comparison should include the intergovernmental implications of each approach, as well as its immediate purpose (see Exhibit IV-6). For example, if there is a national need for innovation and greater spending, the most appropriate tools are likely to be categorical grants, cooperative agreements, direct loans, loan guarantees, or tax incentives. If the need is more simply for financial support of established programs, block grants and general revenue sharing may be more appropriate. If national standards need to be met, but no major financial need coincides, regulation is most appropriate.

Conclusion. Exhibit IV-7 summarizes the preceding principles and criteria. This provides a guide for reviewing appropriate governmental and private sector roles in public works.

Ibid, pp. 5-6

EXHIBIT IV-6

A SIMPLIFIED GUIDE TO THE POLICY IMPLEMENTATION METHODS

Method	Major Purpose	Intergovernmental Implications
1. Categorical grants	Stimulation of specific innovation and increased activity in narrowly defined fields	High administrative effort; lack of flexibility; matching fund requirements
2. Block grants	General support of a broad government activity. Methods are left to the discretion of grant recipients	Low administrative effort; great flexibility; may not require matching funds
3. General revenue sharing	General fiscal support of recipient governments	Minimum administrative effort and minimum or no programmatic requirements or limitations on recipient discretion; no matching
4. Cooperative agreements	Stimulation of innovation on joint programs for which clear division of responsibility is not easily prespecified	Joint project administration with considerable flexibility
5. Contracts	Federal purchase of a specific product or service	No local discretion (except whether to contract)
6. Direct federal loan	Same as a categorical grant; reduced long-term impact on federal budget	Same as a categorical grant; must be repaid
7. Loan guarantees	Loans made to recipient by the private capital market at more favorable interest rates; negligible impact on the federal budget	Less administrative burden on government for loan processing than direct federal loans; must be repaid
8. Tax policies	Influencing the interest rate of the private capital market	Greater state and local independence; cost will vary depending upon the policy
9. Regulation	[illegible] a national purpose, regardless of finance	May be unnecessarily intrusive; may be financially burdensome on the regulated party; often quite rigid

EXHIBIT IV-7
CRITERIA FOR EVALUATING INTERGOVERNMENTAL ROLES

Principles Justifying Federal Involvement	Criteria for Relinquishing Federal Responsibility	Appropriate Methods of Implementing Shared Responsibilities
Enumerated constitutional powers must be exercised. *Fiscal magnitude* requires federal role. *Multistate dimension* cannot be addressed otherwise. *Uniform activity* is needed nationwide. *Negative spillovers* among states must be prevented or redressed. *Efficiency or effectiveness* of programs can be significantly improved by a federal role. *Redistribution of resources* across the nation is needed for geographic or demographic equity and program effectiveness (this includes emergency responses).	*Federal purpose* is unclear. *Federal program is too small.* *Federal role is minor* relative to state and local roles. *Nonfederal financing* is feasible, assured, and adequate (perhaps including general federal support grants to states with low fiscal capacities backed up by state responsibilities for easing interlocal disparities). *Nonfederal responsibility* would mean greater fiscal and programmatic discipline. *Devolution mechanisms* (including transition measures) are feasible, equitable and simple.	If the purpose is *to stimulate new* and greater activity emphasizing federal leadership use: • Categorical grants • Cooperative agreements • Direct federal loans • Loan guarantees • Tax policy If the purpose is simply to help *support common purposes* (emphasizing state or local leadership), use: • Block grants • General revenue sharing If the purpose is to *require certain activities* (emphasizing federal leaderhip), use: • Direct regulation • Conditional grants or loans (categorical grants are best); makes "voluntary" regulations attached to financial assistance irresistable.

ROLES IN NINE MAJOR CATEGORIES OF PUBLIC WORKS

For each of the Council's nine public works categories[21] this section reviews the evolution of current responsibilities, present issues, and proposals for change.

Highway Roles[22]

The evolution of current responsibilities. Most roads are local. Most of those that are not local (about 24 percent) are owned and operated by the states. The federal role (except on federal lands) is to help finance and set standards for most state and some local roads. There also has been a lead federal role in highway research and planning for many years.

Federal responsibility for highways is specified in the Constitution for postal purposes, is strongly implied by the interstate commerce clause, and is sometimes justified on national defense grounds. However, the federal role developed only sporadically until 1916. That year, a systematic partnership with the states was established through federal grants. Since then, the federal-aid highway system has grown dramatically as private automobiles multiplied and the trucking industry grew. It now includes interstate, primary, secondary, and urban systems. The combined system now encompasses approximately 22 percent of the nation's roadway mileage and 80 percent of all vehicle-miles travelled.

The Interstate and Defense Highway System, designated in 1941 and funded by the federal gasoline tax and highway trust fund in 1956, gave the federal government much of its current dominance in highways. Construction funding has been 90 percent federal, and the system is almost complete. This 90 percent share is much higher than for other federal-aid highway programs.

Until 1976, the federal role was defined in terms of new construction alone. Since then, federal funds have been available for major maintenance, including resurfacing, restoration, rehabilitation, and reconstruction through the 4R program.

Another recent addition is the Federal-Aid Urban System (FAUS), designed specifically to aid roads in metropolitan areas. Although the states are involved, the program comes close to establishing a direct federal-local link. Approximately 80 percent of the urban system mileage is owned and operated by local governments.

Forty-eight states share state-collected revenues with their local governments for roads. The states tap gasoline taxes and other automobile and truck usage revenues, just as the federal government does. A few local governments are allowed by their state to impose supplementary registration fees, personal property taxes on vehicles, and gasoline taxes for road support.

Thus, at all levels of government, highway users help pay for highways through the gasoline tax. Federal-state and state-local relationships are well developed and strong; many local programs depend heavily on federal as well as state funds. Federal requirements have helped develop statewide and metropolitan transportation planning throughout the nation.

Issues concerning governmental roles. Most current proposals for change in highway roles originate at the federal level. The federal role became a public issue during the development of the Surface Transportation Assistance Act (STAA) of 1982. Before STAA, federal user-charge revenues and the other elements of the federal highway revenue system had been seriously eroded by time and inflation. Although STAA eased the financial situation, debate has intensified on several issues.

Current debate on the appropriate post-Interstate federal role suggests two directions. One is to develop new interstate links in response to changes in national development.[23] Another is to refocus the program on local roads that may have been neglected due to the emphasis on the Interstate System.[24]

Many contend that continuing the heavy federal focus on interstate highways is appropriate.[25] However, they stress that the line dividing national-interest roads from others is unclear. In the 1980s, proposals were made to withdraw federal aid from the secondary and urban systems. These steps were proposed under the New Federalism legislation in 1982 and 1983 and in more recent block grant proposals. Such withdrawal would end federal support for collector roads and many urban arterials.

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[21] See the National Council on Public Works Improvement, *The Nation's Public Works* (Washington, DC, 1986), Nine Volumes.

[22] For a more detailed discussion, see Alan Pisarski, *The Nation's Public Works: A Report on Highways, Streets, Roads and Bridges* (Washington, DC: National Council on Public Works Improvement, May 1987).

[23] Ibid., pp. 74, 140.

[24] Ibid., p. 74.

[25] Ibid.

In contrast, a renewed federal emphasis on local roads could ease problems on farm-to-market roads, alleviate urban and suburban congestion, and improve truck access to cities. Urban policy, international competitiveness, and interstate commerce goals are cited in support of this approach.

Another view suggests that the federal government should fund only new construction.[26] In this review, the shift of the federal program to major maintenance programs in the late 1970s is seen as an error. These programs resulted from the delayed completion of the Interstate System; parts of the system had deteriorated before the remainder was finished. Some argue that federal support of maintenance and repair helps balance the program's orientation toward capital programs and focuses the money where the needs are.[27] Others contend that such federal programs intrude on state responsibilities or represent state failures to meet their responsibilities.[28]

Another issue raised in the STAA debate was state-to-state fairness. Some states argued that they received less federal aid than the revenues their states generated through federal fuel and other highway-use taxes. These "donor states" contended that they would be better off without the federal program; they could substitute their own fuel tax for the federal tax. The National Governors Association made this a national issue. However, it is also argued that since the federal program has distributed revenues on the basis of system-wide needs rather than where gasoline taxes were collected, returning revenue-raising responsibility to the states could impair the system-wide objectives of the program.[29]

Finally, the debate crystallized concerns about the character of the federal-state relationship that some argue has eroded.[30] Three main factors have been cited as contributing to this erosion. First, is federal use of the interstate commerce clause to preempt the states' rights to define rules for using the roads. Second, the federal government has required states to conform to many new regulations if they wish to continue receiving federal aid. These regulations cover driving age, drinking age, a national speed limit, and truck access to nonfederally aided highways. Finally, federal budget constraints and breakdowns in the budget process have either reduced or temporarily shut off the flow of dollars to the states. Many states see those dollars as their own, held in trust by the federal government; discontent arises when payments are delayed or burdensome conditions are put on their use.

The 1987 reauthorization of federal-aid highways extended the established programs for another five years.

Proposals for change. Three potential responses are suggested by the current tensions in the federal-state highway partnership:

- Devise a new national goal for the federal highway program and redesign programs to meet it.
- Recognize that the completion of the Interstate System shifts the appropriate federal goal to maintenance and augmentation, placing the federal government in a cooperative support role.
- Restrict the federal interest to the Interstate System; shift responsibility for all other programs to states and localities.

To help find a new national goal for the federal highway program, a major coalition has been formed.[31] One option this organization may consider is a redefined system of National Interest Highways. Such a system might start with the Interstate highways and incorporate high-volume segments of the primary system and major truck routes. This could give large long-haul trucks easier access to significant terminals. Under such a scheme, the federal government could take financial and standard-setting responsibility. The revenue-raising capacity of the Highway Trust Fund could be adjusted to meet that responsibility at a high federal share (such as the Interstate System 90 percent). Federal support for other federal-aid system highways might be at a lower level (such as 20 to 50 percent). The latter systems could be subject to minimal federal standards, mandates, and regulations.

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[26] Ibid., p. 75.
[27] Ibid.
[28] Ibid.
[29] Ibid.
[30] Ibid., pp. 75-76.

[31] The twelve organizations creating the Transportation Alternatives Group (TAG) of the TRANSPORTATION 2020 program initiated by the American Association of State Highway and Transportation Officials (AASHTO) are as follows: National Governors' Association, National Association of Counties, National League of Cities, American Association of State Highway and Transportation Officials, Highway Users Federation, National Conference of State Legislatures, U.S. Conference of Mayors, National Association of Regional Councils, American Public Works Association, American Public Transit Association, American Automobile Association, American Trucking Association; AASHTO has also created an Advisory Committee on Highway Policy, which now has over 100 organizations associated with it. The ACHP and state transportation agencies are in the process of holding public forums nationwide, nearly half of which are now completed.

The second option, a supporting federal role, might take a block grant approach such as that proposed by the Administration in 1982 and 1983.[32] Because of its special nature, the Interstate System might remain outside the highway block grant, and its funds could be shifted from new construction to major maintenance. The block grant, then, could encompass the remainder of the federal-aid system. It could remove current distinctions between the primary, secondary, and urban systems; reduce or eliminate the construction bias; and reduce or eliminate costly rules, regulations and mandates. Opposition to this approach cites the budget cuts that often accompany block grants and the concern that many requirements may not be eliminated.

The third option, limiting federal interest to the Interstate System, could eliminate other federal highway responsibilities and release commensurate portions of the Highway Trust Fund. Many variations are possible; for example, the Interstate System might or might not be included in a turnback package.[33]

Evaluation of proposed highway role changes. The Interstate Highway System is an important expression of national purpose. Although highway maintenance, even on the federal-aid systems, has traditionally been defined as a state or local responsibility, there is now more than a decade of precedent for federal aid for major resurfacing, rehabilitation, restoration, and reconstruction (the 4R program). If this federal role is continued, the major intergovernmental issue concerns the unreliable flow of funds from the Federal Highway Trust Fund in recent years.[34]

The extent to which the Interstate System should be augmented with additional mileage is now under consideration. However, many miles of federally aided highways are not as important nationally as the Interstate System. The states and local governments have greater interest in many noninterstate highways and can administer them without strong federal supervision. Nevertheless, if the residual federal aid mileage were converted into a block grant, the Urban System might lose its identity, and local officials might lose their role in determining project priorities. Careful block grant design could accommodate those interests and maintain a strong federal support role for certain local roads.

Whether these residual highway miles should be turned back is a difficult issue. The decision involves weighing the benefits of the present program against the benefits of program simplification and increased state and local autonomy. ACIR recommended a highway turnback on a split vote, with a vigorous dissent by three members citing such factors as uncertainty that the programs would be continued by the states, the likelihood that local influence on the program would be lost or diluted, and the possible loss of portions of the earmarked gas tax.[35] An ACIR survey indicates that some states might not reinstate the full federal gas tax turnback, and that those that do enact part or all of it may not earmark all the revenues for highway or transportation purposes.

The state highway role would not change greatly unless there is a federal highway turnback. In that case, the states would have to reenact the turned-back portion of the gasoline tax and decide what program to fund with it, or the program would be lost. Under a block grant, administration would be simpler and the state would have more policy discretion. Distribution formulas could remain the same.

On balance, it is likely that the federal, state, and local governments will continue to play significant roles in highways, streets, roads and bridges; the precise delineation of system responsibilities is now being reconsidered at this time, and any judgement about shifting those responsibilities should await the results of the established consensus process referred to above.

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[32] Pulaski, op. cit., pp. 74-81, 143-144.

[33] Advisory Commission on Intergovernmental Relations, *Devolving Selected Federal-Aid Highway Programs and Revenue Bases: A Critical Appraisal* (Washington, DC, September 1987).

[34] Ibid., p. 1.

[35] Ibid., p. 2.

Airport Roles[36]

The evolution of current responsibilities. Federal grants for airport development began as part of general public works programs during the Great Depression. They were formalized into a specific airports grant program in 1946. The present program requires and supports statewide and metropolitan airport system planning that contributes to preparation of the biennial National Plan of Integrated Airport Systems.

Since 1970, these grants have been made from the Airport and Airways Trust Fund, supported by an 8 percent tax on airline tickets and other federal excise taxes related to airport operations. This trust fund also covers the Federal Aviation Administration's (FAA's) capital expenses for the airspace control system and some of the agency's operating costs.

The national interest is probably greatest in the larger commercial airports that carry most of the passengers and air freight. However, most of these are locally owned and operated, and many are financially self-sufficient because of long-term airline commitments, landing fees, and revenues from franchises. Recognizing different levels of need, the present grant program contributes about 31 percent of the capital investment for such commercial airports, but nearly 90 percent for reliever and other general aviation airports. Although congestion problems exist at major commercial airports, the present grant program is generally viewed as adequate.[37]

Issues concerning governmental roles. Several issues give rise to proposals for reform. First, many airports depend on federal aid, but that aid is not reliably forthcoming. The federal Airport Trust Fund is accumulating a sizeable uncommitted balance while recent capacity needs go unmet, and the federal program does not address the increasingly serious landside congestion problems. In addition, the national airports plan includes about 1,000 fewer airports than state airports plans. Finally, the federal grants are split almost equally among medium to large commercial airports, small commercial and reliever airports, and general aviation airports. This split gives relatively little recognition to differences in the need for aid among these three groups.

Proposals for change. The most common proposals to modify airport aid focus on reducing federal financial or administrative involvement. Key alternatives include better targeting of federal aid; state administration of airport grants; or discontinuing federal aid.

With respect to better targeting, one approach would limit eligible airports to those that are both of primary national significance *and* in need of aid. Eligible facilities might include the following:

- Large and medium-sized airports facing difficulty getting bond financing for such purposes as buying land for expansion.
- Small commercial airports without enough market strength to ensure self-sufficient financing.
- General aviation airports designated as relievers by the FAA and also without self-sufficiency.
- Major noise abatement projects (including significant remedial land purchases) that may strain the commercial pricing structures of the airlines.

State administration of Trust Fund grants could be either complete or partial. The proposal by the National Association of State Aviation Officials would divide responsibility by type of airport.[38] Federal responsibility would remain for primary hubs, noise, and critical capacity and safety programs. States would be responsible for nonhub commercial, reliever, and general aviation airports, and state system planning. State revolving loan funds would help meet extraordinary airport needs (acquiring a new site or developing noise easements). States are well positioned to help resolve difficult siting questions for new airports and to help preserve existing airports. Siting difficulties frequently present greater barriers to expanding capacity then funding difficulties.

Currently, no significant proposal exists to discontinue federal airport aid.

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[36] For a more detailed discussion, see Apogee Research Inc., *The Nation's Public Works: A Report on Airports and Airways.* (Washington, DC: National Council on Public Works Improvement, May 1987.) The air traffic control system, which is almost completely a federal responsibility at present, is likely to stay that way even if the air traffic control function were to be spun off as an independent federal corporation (like the Postal Service), as proposed by the Air Transport Association. Therefore, it is not considered here.

[37] Ibid., pp. 94-98. In December 1987, Congress reauthorized this program with a substantial increase in spending but little change in program structure. Significantly, Congress added a provision to reduce aviation-related taxes flowing into the Airport and Airway Trust Fund if appropriations fall significantly below authorizations.

[38] Ibid., p. 101.

Evaluation of proposed airport role changes. Retargeting the airport categorical grant program away from airports that can find adequate financing elsewhere would reflect the principle that federal financing should be used only if other resources are unavailable. Because the effect would be to turn back financing authority to the airports, removing present federal restrictions on passenger head taxes at such airports could provide compensating revenues.[39]

The proposal to shift greater grant administration responsibility to the states will be tried out on a demonstration basis in up to three states for fiscal years 1990 and 1991 under Sec. 116 of the Airport and Airway Improvement Amendments of 1987.

Mass Transit Roles[40]

The evolution of current responsibilities. Traditionally, the private sector was often the principal provider of mass transportation, except for core service in the nation's major cities. However, in the 1960s concerns about lagging profitability as well as deteriorating equipment and service led to increasing government involvement. The first federal program came from the Housing Act of 1961, which provided a small loan program of $10.5 million per year for capital assistance, and a small demonstration grant program of about $2.2 million per year to develop and publicize improved mass transportation methods.[41] The Urban Mass Transportation Act of 1964 created a larger discretionary capital grant program and began support for essential public buyouts of ailing private systems. In 1974, federal funds were added for operating subsidies.

The effect of the federal program has been to buy out the nation's faltering private mass transit systems, place them in local government hands, and mitigate the postwar decline in transit ridership. Labor protection minimized the effect on union members in this private-to-public shift. The federal program also mandated special access for the handicapped, low fares for the elderly, and other social equity requirements. Although the program now contributes modestly toward the operating costs of most local systems, the bulk of the current federal funds is devoted to capital construction or the purchase of new buses and rail cars. The federal program also requires and assists coordinated highway and transit planning in metropolitan areas. Finally, in recent years, a rural component has been added to the federal transit program; it is administered through the states.

Federal transit funding has been falling. The combination of state administration of the rural program and falling federal funding has brought every state into the program and has dramatically increased state transit funding. According to the American Association of State Highway and Transportation Officials (AASHTO), state funding for transit has become larger than the federal share. In Fiscal Year 1988, states will spend over $3.5 billion compared to about $3.1 billion in federal aid. State and local governments are, and for several years have been, exerting an increasing role in transit planning and policymaking, and they and the transit agencies have become more active in research.

Issues concerning governmental roles. Critics of the federal program question whether there is still a clear national interest now that the shift from private to public ownership has been accomplished. They also question the program's bias toward capital spending, the feasibility of making wise and timely choices nationally about investments in major new local rapid-rail and light-rail projects, the added costs of federal mandates, and the program's ability to meet all needs equitably with shrinking federal resources.[42]

Until 1982, federal program monies came exclusively from the general fund. When the federal gasoline tax was raised to 9 cents, 1 cent was dedicated to funding new transit systems. The general fund portion of the program was turned into a block grant that can be spent in part to meet operating costs. These grants are allocated by formula to help local urban transit authorities and to help states meet rural and small town transit needs. The block grant portion has been cut substantially since 1983, but states have made up much of the cut.[43]

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[39] Defederalization proposals have been studied several times. See, for example, U.S. Department of Transportation, *The Effects of Airport Defederalization* (Washington, DC, February 1987).

[40] For a more detailed discussion, see The Urban Institute, *The Nation's Public Works: A Report on Mass Transit* (Washington, DC: National Council on Public Works Improvement, May 1987).

[41] Advisory Commission on Intergovernmental Relations, *Impact of Federal Urban Development Programs on Local Government Organizations and Planning* (Washington, DC: U.S. Government Printing Office, May 30, 1964), pp. 50-55.

[42] The Urban Institute, op. cit., pp. 64-75.

[43] Ibid.

In recent years, some local governments have established new bus and light-rail systems with their own funds to escape the high costs and delays of the federal program.[44] A few larger cities like New York, Boston, and Chicago draw primarily on state and local sources for transit funding, because the federal program is not sufficient to meet their needs.

Overall, however, federal requirements and funding exert substantial influence over urban mass transit policies. This is so, even though federal funds meet only 60 percent of public capital expenditures and only 9 percent of operating costs.

Therefore, the major governmental roles question is: what will happen if the federal share of transit funding continues to decline? Will state and local governments assert substantially greater influence over transit research, planning, and policymaking? Or will they be led disproportionately by the structure, requirements, and priorities of the federal program?

Proposals for change. After a review of recent evaluations, The Urban Institute's report to the Council on mass transit suggested that the federal transit program has been directed too narrowly at sustaining and expanding traditional rail and bus transit systems serving central cities. While this has helped expand service and reverse ridership declines, the study suggested that the federal program had not adjusted adequately to suburbanization. The percentage of all travel which uses transit has declined as has the transit share of all work trips (traditionally the major transit market). Therefore, the study concluded, a major restructuring of these programs could be beneficial.

Several proposals have been made to restructure the federal transit program. President Reagan's New Federalism initiative for fiscal year 1983 proposed a very broad turnback including transit as well as the noninterstate highway programs.

The proposed Federalism Act of 1986[45] would have eliminated the formula portion of the transit program as part of a broad exchange of responsibilities. However, the transit and highway programs supported by the Highway Trust Fund were not included in this proposed swap.

The 1986 National Governors' Association draft proposal for turning back all noninterstate highway programs and all 9 cents of the gasoline tax included the 1 cent mass transit capital grant program.

After reviewing these and other proposals, the report prepared for the Council suggested that all federal funding for transit be combined into a single block grant without distinctions between capital and operating spending. The rationale was to eliminate bias toward publicly owned, capital-intensive transit, and to provide the funds to designated local recipients other than operating agencies to help ensure objective performance-based decisions. At the present level of funding, formula allocation among all transit systems would drop the federal share to 20 or 25 percent of total spending.

The Urban Institute proposal also recommended working toward closer coordination between urban transit and highway programs. Although procedures for planning and coordination, and the ability to transfer some interstate highway funds to transit have been available for over a decade, the proposal urged eventual consolidation of local transit and highway programs.

Evaluation of proposed mass transit role changes. With public ownership of transit now established and ridership stabilized, and without a clear national urban policy, the appropriate federal role may be one of support rather than leadership. Block grants that provide stability in state and local planning may be suitable vehicles for carrying out the future federal role. A lower federal contribution could place more responsibility on recipients to use the most cost-effective methods of providing services, thereby increasing fiscal discipline. Funding allocation formulas could be redesigned to reward improved performance and encourage innovative operations. And the designation of a neutral policymaking organization as a recipient (rather than a particular service provider) might help ensure competition. These incentives might help address one of transit's most serious current problems: falling productivity.

A unified federal block grant for transit would require little state-level change, other than increased pressure from local transit systems for more state aid for major capital investments. Some transit operators believe that discontinuance of the federal discretionary construction grant program would jeopardize most new rail transit systems.[46]

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[44] Examples include the San Diego, California light rail system, and a local bus system in Montgomery County, Maryland.

[45] Based upon the 1984 report of The Committee on Federalism and National Purpose.

At the local level, such a block grant would go to a transit-policy body not associated with the local transit authority or bus system. Options might include an existing regional council in multijurisdictional areas, or the county government in single-county metropolitan areas. Many transit operators, however, believe that it is better to expand the scope of existing transit agencies to incorporate all transit responsibilities, including contracting with private service providers. That approach would substitute coordination of services for greater competition among providers in an effort to achieve improved economy and efficiency.

Finally, however, if the current reevaluation of national transportation goals produces a clear national consensus about transit, then continued use of categorical grants might be appropriate. On balance, Council research confirms that the federal transit program is in transition.

Intermodal Transportation Roles[47]

The evolution of current responsibilities. Broadly defined, intermodal transportation is the movement of passengers and freight by two or more modes of transport. These trips often involve both public and private conveyances.

A commuter, for example, may travel by car over local, state, and interstate roads and end at a public or private parking facility. The commuter may also use public transit, a commuter railroad, a ferry boat, and walk. Increasingly, business trips involve intercity travel by bus, train, or airplane.

How smoothly these trips proceed depends on how well the transportation planners have worked together. The 3-C (comprehensive, coordinated, and continuing) transportation planning process mandated by the U.S. Department of Transportation addresses the problem to a limited extent. However, the modes operate independently. Private transportation providers are seldom involved in the planning, and intermodal transfer receives little more than moral support.

Similar freight transfers occur, involving a much larger private sector component. Federal deregulation of trucks, railroads, and airlines, along with rapidly advancing transportation technologies, have made these linkages increasingly complex. They have become crucial to the nation's commercial strength and international competitiveness. Freight forwarding companies link the modes administratively. However, they cannot do much about inadequate physical links.

Transportation accounts for an important part of the cost of producing and marketing most products.[48] Raw materials may be imported by ship, barge, train, and truck. Intermediate components may be shipped by truck, rail, or barge to assembly plants. Finished products may be forwarded to foreign and domestic markets by truck, rail, barge, and ship. Conversely, imports need efficient transfer from ships to trains, barges, and trucks.

Increasingly, freight is containerized and marked for automated transfer from one mode to another. However, congestion and administrative complexities at ports and other transfer points can delay shipments to the detriment of the nation's economy. The introduction of the "just-in-time" inventory concept makes the economy even more dependent on efficient and reliable systems for moving and transferring freight from one mode to another. Highway departments, truckers, railroads, barge companies, port authorities, inland waterway administrators, freight terminal operators, and airport managers all must cooperate.

Issues concerning governmental roles. No national focus on intermodal transportation now exists. In addition, the planning data needed to track freight movements have grown increasingly scarce since deregulation. Most such data were collected to regulate the trucking, intercity bus, railroad, and airline industries. Is a larger federal role in intermodal transportation necessary? If it is, how can the needed information be obtained?

Proposals for change. Intermodal transportation does not present a construction finance issue. Rather, it presents a coordination and planning problem. The report prepared for the Council on intermodal transportation recommended a federally supported focal point for advocating national coordination. A new office of intermodal transportation coordination could report to the Secretary of the U.S. Department of Transportation. Such an office might be assisted by a new productivity council on intermodal transportation. The council could represent private sector transportation companies as well as transportation interests from all levels of government. The issues to be addressed include ways to:

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[46] Working group meeting on mass transit, New York City, November 19, 1987.

[47] For a more detailed discussion, see Joseph S. Revis and Curtis Tarnoff, *The Nation's Public Works: A Report on Intermodal Transportation* (Washington, DC: National Council on Public Works Improvement, May 1987).

[48] The amount of public transportation infrastructure used by U.S. industries in 1984 has been estimated by the U.S. Department of Commerce at $25.5 billion. See U.S. Department of Commerce, "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services," prepared for the National Council on Public Works Improvement, July 30, 1987, pp. 5.9, 5.17.

- Improve freight movement data.
- Establish standards to ensure equipment and facility compatibility.
- Reduce administrative barriers to freight movement.
- Help resolve labor-management problems.
- Focus urban planning on effective intermodal transportation.

Evaluation of proposed intermodal transportation role changes. This issue is nationwide in scope, important to the nation's competitive position in world markets, and linked directly to interstate commerce and industry. It is not now being addressed, and no other level of government is capable of dealing with it.

Water Supply Roles[49]

The evolution of current responsibilities. Most urban water is supplied by local governments, special districts, or private companies that charge the users for their service. Although not all recover their full costs, Council research suggests that there is little reason why most large systems could not if they keep good records and operate as enterprise funds. Water, on average, is one of the least expensive utilities. No major federal grant or loan programs exist in this field except in the West where low-cost water is supplied from major federal impoundments. In the West, present allocations of supplies are historically based and reflect agricultural rather than urban uses. Many smaller systems, with limited rate bases, may need help meeting the higher costs of satisfying increasingly stringent water quality standards.

Issues concerning governmental roles. The main issues in water supply for most of the nation are full cost recovery, compliance with new federal drinking water standards, and groundwater contamination from ground disposal of wastes and agricultural practices. Small systems, which form the vast majority of the nation's water systems, often find dealing with those issues difficult due to their high unit costs and limited resource bases.

In the West, water supply issues center around needs to conserve agricultural water, to avoid excessive groundwater drawdowns, and to transfer water rights to match shifting uses.

Proposals for change. The report prepared for the Council on water supply suggested that the principal ways to promote full-cost recovery by municipal water systems are to either enlist the federal government in concert with the states or to enlist the states by themselves. The federal Safe Drinking Water Act could be amended to require states to change enabling acts for public water systems. Under such guidelines, water supply agencies would have to set their prices for full-cost recovery; public utility commissions would set the same standards for regulated water companies. Alternatively, model state legislation could be developed and promoted for voluntary adoption by the states. Smaller systems that lack the financial resources to comply with such legislation might need some form of regional consolidation, interlocal or private sector contracting, or a joint-powers arrangement.

Proposals to conserve agricultural water and reallocate water among shifting uses in arid areas center around full-cost pricing. Solutions to excessive groundwater drawdowns involve conservation measures and regulations to limit withdrawals.

Evaluation of proposed water supply role changes. The present federal role in drinking water is primarily regulatory, not financial. Council research suggests that the use of federal regulatory authority to advocate full-cost pricing by local water authorities could be effective. However, intergovernmental principles would suggest that if a state or locality would prefer to support water supply services with general revenues rather than user fees, this option should be left open.

If federal guidelines for advocating full-cost pricing of water were established, states would implement them. In the absence of federal guidelines, states could take the same action on their own initiative. Needed help for small water systems could come from state action to restructure them into larger, more economical ones, to develop regional approaches and water system interconnections designed to save money and improve reliability, and to provide research and technical assistance.

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[49] For a more detailed discussion see Wade Miller Associates, *The Nation's Public Works: A Report on Water Supply* (Washington, DC: National Council on Public Works Improvement, May 1987).

Council research suggests that conservation and reallocation of western water from federal dams could be given a boost if the federal government charged full costs to users. Reallocations of water rights take place largely under state laws and market conditions. Solutions to groundwater problems are evolving; the need for a new federal role is unclear.

Wastewater Treatment Roles[50]

The evolution of current responsibilities. Most wastewater treatment programs are carried out by local governments or special districts. There have been nearly 30 years of federal grants; however, the method of financing is changing. Congress and the President have enacted legislation to convert the federal grant program into state revolving loan programs by 1990. These loans will have to be paid back largely by user fees, since state grants for this program are neither common nor large.

Issues concerning governmental roles. It appears that the local governments and special districts that operate wastewater treatment programs will have to move away from outside grants toward full-cost recovery pricing. This is not current practice. For example, large systems, which might be most able to recover their full costs, set their rates at an average of 11 percent below their operating costs. Even systems that do recover their operating costs through rates seldom charge enough to cover capital costs; in many places, sewer bills are more underpriced than water bills.

Proposals for change. The report prepared for the Council on wastewater management proposes that EPA regulations governing new state revolving loan funds require states to insist that local loan recipients set their sewer rates to cover full operating and capital costs. That could translate into substantial increases over today's rates. The increases would occur because, even with federal grants, the need for new capital spending is still above current investment levels.

Full-cost pricing would create incentives for the local sewer agencies to find supplemental income (such as developer-impact fees). It also would encourage the agencies to press for less expensive ways to meet water quality standards. One possibility suggested to the Council is contracting out certain operations by competitive bid; another is seeking authority to use flexible discharge limits.

Evaluation of proposed wastewater treatment role changes. Council research suggests that federal advocacy of full-cost pricing in the wastewater treatment program should be tempered, as for water supply, with an option for state or local use of general revenues as an alternative.

Research prepared for the Council suggests that unmet wastewater treatment needs still may be quite substantial, and the federal government should make a special effort to provide enough flexibility in regulatory standards to ensure that costs are not artificially inflated.

Water Resources Roles[51]

The evolution of current responsibilities. The federal government has long been responsible for major water resources projects, such as dams, port dredging, inland waterways, irrigation, and flood control levies. However, most projects of high national significance have already been built. For the remaining projects with less national importance, it has been argued that substantial cost-sharing with beneficiaries is appropriate. Diverse political reactions to these shifting circumstances prevented Congress from passing any major water resources legislation between 1976 and 1986. The act that finally passed in 1986 established new cost-sharing provisions. These will bring federal, state, and local project sponsors into closer contact in designing, completing, and operating projects.

Issues concerning governmental roles. Following enactment of the 1986 legislation, many state and local participants have made clear that they will demand less expensive designs if they are to participate financially. They also want greater influence in determining the nature of projects. Many of these projects already face long and arduous approval processes that may be made even more difficult by the added requirements for cost-sharing. This suggests that effective negotiating and mediating skills are likely to be needed more frequently. The shift from major new projects to the maintenance and management of existing facilities also will require new skills and data. Risk-cost analysis and risk-sharing strategies will be needed in addition to benefit-cost analysis.

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[50] For a more detailed discussion see Apogee Research Inc., *The Nation's Public Works: A Report on Wastewater Management* (Washington, DC: National Council on Public Works Improvement, May 1987).

[51] For a more detailed discussion see Kyle Schilling et al., *The Nation's Public Works: A Report on Water Resources* (Washington, DC: National Council on Public Works Improvement, May 1987).

Proposals for role changes. The report prepared for the Council proposed that the former national Water Resources Council and regional river basin commissions be reestablished in some form as coordinating forums. These forums would address such issues as cost-sharing, maintenance, risk analysis, and risk sharing; would monitor changing conditions that may need broad-based responses (such as aquifer drawdowns and sea level changes); and would promote research and innovation transfers to improve cooperative management (see Chapter VI). These forums could help conduct an intergovernmental assessment of the condition of levees and flood walls, and could advocate improved beneficiary identification and cost-recovery procedures.

Evaluation of proposed water resources role changes. The protracted Congressional debate culminating in the new cost-sharing legislation of 1986 seems to have set these programs on a new course for the foreseeable future. A national water resources council and a series of federal-state river basin commissions did exist at one time; now, with a significant intergovernmental effort again underway (because of cost-sharing), national and regional coordinating forums might be useful in smoothing the path toward achieving common objectives.

In a coordinating process such as this, states would be represented selectively on a new national water resources forum, and all states could be represented on regional river basin commissions. Among the many issues to be tackled could be more widespread state action on dam safety for nonfederal dams (including regular dam inspection programs) and urban stormwater programs.

State and local investment in flood control and urban drainage, including local storm sewers, is already large. For example, some 8,000 upstream flood control structures provided by the U.S. Department of Agriculture are maintained by local sponsors. As future activity focuses increasingly on smaller, more localized projects, the proportion of nonfederal involvement is expected to rise.

Solid Waste Disposal Roles[52]

The evolution of current responsibilities. Traditionally, solid waste disposal has been a local or private sector enterprise. Rising environmental concerns have involved the states and the federal government in policymaking and regulation. But there are no big grant programs. Financing is basically on a self-sustaining basis.

Current issues concerning governmental roles. The main issue is the scarcity of disposal sites (typically either modern sanitary landfills or mass burn waste-to-energy facilities). The difficulty of siting new facilities in populated areas has several intergovernmental implications. First, it suggests making joint use of any site that can be found. Second, it suggests using outside help to find sites beyond the borders of the localities needing the site. And third, it suggests extending the life of existing landfills by reducing the volume of material going into them.

Proposals for change. The report prepared for the Council on solid waste offered the following proposals:

- Federal requirement of financial assurance plans for regulated landfills.
- Federal programs in concert with waste-producing industries to reduce the amount and modify the type of waste produced, encourage recycling by the producing industries, and create markets for recyclable material.
- State help in identifying solid waste disposal sites, getting them approved, and certifying operators of landfills and waste-to-energy facilities.
- Regional cooperation among local governments (encouraged by the states), to promote joint use of available solid waste facilities.
- Local provision of convenient recycling.

Evaluation of proposed solid waste role changes. The purpose of financial assurance plans for regulated landfills is to document how landfill owners and operators would develop, operate, maintain, close, and perpetuate the safety of the site.

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[52] For a more detailed discussion see R.W. Beck Associates, *The Nation's Public Works: A Report on Solid Waste* (Washington, DC: National Council on Public Works Improvement, May 1987).

The proposed federal role in advocating and supporting waste reduction and recycling would require substantial cooperation from major nationwide industries. Only the federal government has adequate scope and powers to attempt this role.

Hazardous Waste Management Roles[53]

The evolution of current responsibilities. Hazardous waste programs are relatively new and still developing. The federal government has provided much of the leadership in regulation and in cleaning up past contamination. Some states, however, now have even stricter regulations than the federal government.

The federal program to ensure adequate disposal sites for currently generated hazardous waste involves the states. 39 states have qualified to administer the program. Federal law holds the state responsible for ensuring adequate future disposal capacity, but offers no help. Either the industrial firms that produce the waste or private contractors who specialize in such work complete the actual cleanup work.

Issues concerning governmental roles. Local governments, with their basic land use controls, have only limited involvement in hazardous waste site selection or cleanup decisions. The federal government also has only limited involvement. In addition, few are focusing on reducing the generation of hazardous waste. Finally, no one is taking a strong role in research, development, and the transfer of new technologies in this fast-changing field.

Proposals for change. The report prepared for the Council on hazardous waste disposal offered proposals for new roles in response to all three major issues. With respect to siting, proposals lead in two directions. The first includes local governments in siting decisions to help mitigate the effects on surrounding land uses. The second proposal establishes a federal role in the siting process to guide states on a number of thorny questions that have arisen concerning compliance with the Superfund Act and to help avoid frustrating the siting purposes of federal law.

New federal initiatives have also been proposed with respect to hazardous waste reduction and a broad range of research and development. The following areas were suggested for ongoing exploration:

- Ways to reduce waste generation.
- The best practices in state siting programs.
- Successful public/private partnerships.
- Improved incineration techniques.
- Ways to reduce, limit, or share risks and liabilities.
- Benefit-cost and risk-cost analysis techniques.
- Nonregulatory alternatives for controlling hazardous waste.

Evaluation of proposed hazardous waste role changes. The federal government is in a unique position to undertake a new role in advocating hazardous waste reduction.

Even with successful waste reduction programs (which are still beyond the horizon), usable hazardous waste disposal sites are essential. Sites are extraordinarily difficult to find and approve because of adverse public reaction. Although the federal government's complete reliance on the states to supply the needed sites is in line with sound intergovernmental principles, the difficulty of the task, states' geographic limitations, and the difficulty of convincing one state to voluntarily accept hazardous wastes from another may make a stronger federal role in siting necessary and appropriate.

Finally, the proposed further involvement of both states and localities in the federal hazardous waste programs would put governmental decisionmaking closer to the people. The states are aggressively moving in this direction, but local governments are still hardly involved. In view of their primary role in controlling land use, localities have essential contributions to make in the siting of disposal facilities.

SOME GENERAL ISSUES CONCERNING GOVERNMENTAL ROLES

Running through most of the nine major public works studies, and through several other Council studies, are common themes concerning government roles and intergovernmental arrangements.[54] These pertain to the following:

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[53] For a more detailed discussion see Apogee Research, Inc., "The Nation's Public Works: A Report on Hazardous Waste Management" (Washington, DC: National Council on Public Works Improvement, May 1987).

- The need for national leadership in research, development, demonstration, and innovation-transfer programs.
- The reliability of federal trust funds.
- The effects of federal mandates.
- Concern for the needs of smaller public works systems.
- The potential of regional approaches to public works issues.
- Tensions among the various providers of public works at the state and local levels.

The first two issues are treated elsewhere in this report. The other four are examined here.

The Effects of Federal and State Mandates

The current situation. As the federal role in infrastructure financing has declined in recent years, state and local officials have come under increasing fiscal pressures. One response to that pressure has been the call for higher levels of government to compensate them for the costs of complying with regulations or mandates. The discussion that follows focuses on federal mandates that affect state and local governments.

Public works mandates, while costly, generally have worthwhile goals. For example, the Safe Drinking Water Act Amendments of 1986 require significant decreases in the contaminants acceptable in drinking water; the EPA proposes more stringent regulation of solid waste landfills to protect groundwater from contaminants; and the Department of Transportation regulates the design and construction of roads and bridges in order to ensure public safety.

In addition to specific public works program requirements, many federal mandates grow out of more generally applicable constitutional and statutory provisions or court decisions. The following significantly affect public works:

- Access to public facilities for the handicapped.
- Requirements that construction workers paid with federal funds receive wages prevailing in their area.
- Environmental impact analysis.
- Relocation assistance for people and businesses displaced by federally assisted land acquisition and construction projects.
- Intergovernmental consultation before approval and funding of federal aid projects.
- Requirements that public institutions (such as jails, prisons, and hospitals) provide and maintain humane living conditions.

The central issues are, first, whether federal mandates are administered cost-effectively, and second, whether the federal government should compensate state and local governments for the costs of complying with these mandates. While not all federal laws, regulations, and court orders that impose costs on state and local governments warrant compensation, grounds exist for reimbursing all or some of the costs of complying with certain federal mandates.

Some examples of unnecessarily or unexpectedly high-cost mandates are: retrofitting all public facilities and transit fleets to serve the handicapped, requiring that the highest technically feasible level of wastewater treatment be installed in all new plants, requiring that sewage effluent quality be equally pure under all circumstances, and requiring that standard highway design and safety criteria be applied equally under a wide variety of conditions (see Exhibit IV-8).

Congress has required that a fiscal impact analysis accompany any legislation that would have substantial financial effect on state and local governments before such legislation can be voted on in either house of Congress.[55] The idea is to avoid enacting new mandates without recognizing the costs that would be imposed, and to encourage exploration of less costly alternatives. Implementation of the requirement, however, has been sporadic at best.

Similar requirements regarding state mandates on local governments have been enacted in 42 states and have been taken more seriously in several states

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[54] Several of these themes were identified in Apogee Research, Inc., "A Synthesis of Policy Recommendations of Eight Public Works Reports," prepared for the National Council on Public Works Improvement, June [illegible], 1987.

[55] The State and Local Cost Estimate Act of 1981, Public Law 97-108.

EXHIBIT IV-8. IMPACT OF CERTAIN REGULATIONS ON PUBLIC WORKS

Category of Public Works Type of Regulation	Airports and Airways	Highways, Streets, Roads & Bridges	Mass Transit	Wastewater Treatment	Water Resources	Water Supply	Hazardous Waste Management	Solid Waste
Economic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	††b	0	0
Environmental	[illegible]			††	†	[illegible]	††	††
Public health	[illegible]	[illegible]	[illegible]	[illegible]		††	_c	_c
Labor market	[illegible]	[illegible]	††	††	††		0	0
Worker safety								–
Design standards	[illegible]	††	††	[illegible]	†	[illegible]	[illegible]	_c
Handicap			†	[illegible]		[illegible]	0	0
Procurement		†	†	[illegible]		[illegible]	[illegible]	0
Project selection criteria	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0

KEY: †† Major impact † Lesser impact – Minimal impact 0 Not applicable

[illegible]

SOURCE: Apogee Research, Inc., "Government Regulation and the Provision and Cost of Public Works," prepared for the National Council on Public Works Improvement, October 13, 1987, p. 8.

than at the federal level.[56] In 12 states, reimbursement of the costs of certain mandates is required in some cases.

State mandates include a range of constitutional, statutory and administrative requirements on local governments broader than federal mandates. State mandates cover (1) organizational and operational procedures of local governments, (2) programmatic service standards, (3) interlocal relationships, (4) local tax base limits, and (5) personnel standards and benefits.

States justify mandates on local governments on the grounds that they promote desirable social and economic goals of significant statewide importance. However, localities often view these mandates as intrusions into their political accountability and their authority to make responsible programmatic and financial decisions. According to ACIR, "Local government officials are especially critical of state laws pertaining to the salaries, job benefits, and working conditions of local government employees."[57] States that set the level of welfare payments and then require localities to come up with about half the funds to meet those costs also generate severe criticism. In the public works field, state mandates often parallel federal mandates such as those for construction wages (Davis-Bacon) and environmental protection.

Current proposals. The U.S. Advisory Commission on Intergovernmental Relations has advocated reimbursement for the "national interest" portions of costs attributable to new federal mandates.[58]

The U.S. Treasury Department has suggested the following series of criteria to define those situations where federal reimbursement is most appropriate:[59]

- Federal regulations pertaining to individuals' Constitutional and statutory rights, and to "general rules of the game" for the economy cannot demand compensation. These general rules include provisions covering such things as minimum wages, work hours, and benefits.

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[56] Advisory Commission on Intergovernmental Relations, The States and Distressed Communities: The Final Report (Washington, DC, November 1985), p. 163-1[illegible]

[57] Ibid., p. 164.

[58] Advisory Commission on Intergovernmental Relations, *Regulatory Federalism* (Washington, DC, February 1984), p. 265.

[59] Office of State and Local Finance, Department of the Treasury, *Federal-State-Local Fiscal Relations: Report to the President and the Congress* (Washington, DC: U.S. Government Printing Office, September 1985), pp. 24-25 and 90-92.

- Costs of complying with environmental regulations should be paid by polluters, not by the general taxpayer.
- The costs of complying with federal regulations not related to grant programs should be reimbursable if they (a) are applicable uniquely to state and local governments or impose substantial obligations on state and local governments because they have enforcement responsibilities under the federal regulation in question, and (b) involve costs to state and local governments that exceed the benefits to the areas they serve.

With respect to state mandates, ACIR has recommended that states exercise deliberate restraint through a process of:

- Inventorying existing mandates.
- Ascertaining whether they are of statewide interest.
- Establishing procedures for weeding out unnecessary mandates.
- Establishing a fiscal analysis process to identify the costs of mandates.
- Providing full state reimbursement for state mandates if state-imposed tax limitations seriously constrict local revenue raising ability, and when the state mandates local employee compensation, hours, working conditions, and pension benefits.
- Providing partial reimbursement for required enhancements in programs whose benefits accrue in part beyond local borders, including education, highways, health, hospitals, and welfare.[60]

Conclusion. Council research suggests that state and federal mandates significantly affect the costs of providing public works. These costs should be identified through fiscal analysis during legislative initiation or review. Reimbursement of some mandated costs may be appropriate when the costs exceed the benefits to the area served.

The Special Needs of Smaller Public Works Systems[61]

The current situation. Public works facilities come in all sizes. However, attention tends to focus on the largest facilities: the Interstate Highway System, subways, international airports, and large-city water-supply systems. These are often dramatic in scale, serve many people, and have national economic and social impact.

Relatively little attention is paid to the much more numerous small or low-density systems. These provide the same important services as do their larger counterparts.

There is no single definition of a small system. Instead, there is a series of definitions, for example roads and bridges off the federal-aid highway system; transit authorities with fewer than 25 buses; public general aviation airports; small commercial airports; water supply systems with fewer than 3,300 users; wastewater treatment plants with daily flows under 1 million gallons; and solid waste facilities that serve fewer than 3,300 residents. Under these definitions:

- Most individual public works systems are small, accounting for 83 percent of all facilities.
- Small systems provide a significant, but much smaller, percentage of infrastructure services (ranging from 20 percent for highways to less than 2 percent for transit).
- Small systems are about 20 percent more capital intensive than larger systems.

The term small systems is often thought to mean rural. This is not necessarily the case; small or low-density public works are typical of suburban areas and small cities as well.

Small public works systems face two major kinds of problems: management and financial. Financial problems arise for various reasons. For example, rural communities have lower average per capita incomes than do urban areas, reducing these communities' ability to finance projects independently. Rural areas may also have declining populations and excess facilities, (especially roads), that impose financial strain on state and local governments. Smaller facilities often have limited access to the financial markets. They also are likely to be hit hardest by the need to adjust to the new provisions of federal tax law. Further, because of economies of scale, many smaller public works facilities have significantly higher unit costs. For example, in some situations it costs nearly four times as much to provide a gallon of clean drinking water in a community of 500 as in one of 500,000.[62]

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[60] Advisory Commission on Intergovernmental Relations, *State Mandating of Local Expenditures in Brief* (Washington, D.C.: August 1978), p. 14.

[61] For a more detailed discussion see Apogee Research Inc. and Wade Miller Associates, "Problems in Financing and Managing Smaller Public Works Systems," prepared for National Council on Public Works Improvement, September 10, 1987.

Effective management requires knowledge in finance, planning, operations, and technology. Few small systems can afford such a breadth of experience. Most managers of small facilities wear many hats. Similarly, the data available to help make informed decisions often are limited. These problems can be further compounded by government regulations, which can place a disproportionate burden on smaller operations.

Responding to these special needs. For the most part, smaller public works systems are victims of their situation. They can do little on their own to improve their lot and must look to higher levels of government or neighboring local governments for help: small systems can either become larger through restructuring, or they can stay small and get special help.

The state may be centrally involved in the first approach because of its responsibility for structuring and restructuring local governments. If the state has already provided for regional councils, interlocal contracting, private sector contracting, joint powers agreements, realignment of local boundaries, or consolidation of local governments, it may be possible to capture effective economies of scale through these means. States may help in this process or may initiate efforts to create even greater economies and effectiveness in public works (as they once did in education with the local school consolidation movement).

For those systems staying small and independent, states and the federal government may provide three kinds of special assistance: regulatory flexibility, special financing, and technical assistance.

The federal government enacted The Regulatory Flexibility Act of 1980 to shield small governments (as well as small businesses) against the adverse impact of regulations too complex or time-consuming for these small entities to meet. Several states have followed this federal lead. However, benefits have been disappointing. The process of getting waivers is complex and largely unused.

For financing, most small systems rely on intergovernmental grants for major capital facilities, and those sources have been drying up. The largest (for most small communities, the only) source had been General Revenue Sharing, which has been discontinued. Many other federal grants to small local governments have been cut substantially.

Proposals for replacing these shortfalls include guaranteeing federal loans, state bond banks, and special set-asides in federal grant programs for smaller public works systems.

Finally, crucial among the special means of assisting small systems is the provision of technical assistance. Many sources ranging from professional associations and universities to state and federal agencies are already available. However, two principal problems limit their usefulness to smaller systems: the lack of sound information directly applicable to small systems and the lack of technical expertise within the smaller governments.

Two proposals that would help overcome these limitations are to devote a portion of a national public works research agenda to smaller systems and to establish a special infrastructure "extension service." Regional or local offices located throughout the nation could help supply practical advice to small systems at close range. There also may be a need for state legislation and planning analysis assistance to allow local governments to reduce the size of their infrastructure and allow for abandoning or downgrading uneconomic roads.

The Potential of Regional Organizations

Reports prepared for the Council on the water and waste categories of public works call for greater regionalization. This proposal recognizes that while there are compelling economic reasons for government involvement in these areas, the benefits and costs are neither nationwide in scale, nor do they coincide with the boundaries of any single unit of government.

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[62] Temple, Barker and Sloane, Inc., "Survey of Operating and Financial Characteristics of Community Water Systems," prepared for the office of Drinking Water, EPA, October 1982.

Nonetheless, progress in many areas requires cooperation beyond the local level. Examples include the cleanup of river basins or estuaries and the interconnection of water supply systems in a metropolitan area. Such cooperation involves groups of states or parts of states, coalitions that do not occur naturally within the federal system; therefore, federal and state action may be necessary to encourage this type of cooperation. The options available include regional commissions, interstate compact organizations, regional councils and special districts and authorities, as well as consolidation of existing units, interlocal contracting, and joint exercise of powers. This range of approaches allows accommodation of local needs. In all probability, most local systems would continue to exist for local purposes, but associate with some regional organizations to take advantage of economies and efficiencies and to help meet larger regional needs.

Regionalizing water supply at the metropolitan level is a recommendation of one of the Council's consultants to avoid supply interruptions and provide more cost-effective service. In addition, the wastewater report recommended basin-wide (multi-state) planning and management institutions to coordinate water quality, water supply, water resources development, and economic growth.

Regional problem-solving is also important to highway, transit, and airport programs, in which a great deal of interlocal planning, coordination, and cooperation is essential. This is especially true for intermodal coordination in metropolitan areas.

Overcoming Tensions Among Public Works Providers

The current situation. In general, the studies of individual categories of public works prepared for the Council called for shifts in responsibility away from federal agencies and toward state and local bodies. Such moves would continue recent trends to give greater responsibilities to the levels of government that most directly provide infrastructure services.

The practical effect of shifts already made in this direction has been to enhance the power of states in relation to local governments. The new state-local relationships created in this process frequently add to the traditional tensions between these two levels in many states. Many direct federal-local program linkages that were established when states proved unresponsive to urban needs are in the process of being replaced with state-local links and different financing responsibilities.

Continuing increases in the use of special districts and authorities puts pressure on yet another of the traditional points of tension in the federal system: the conflict between general local governments and special-purpose units. Although special districts and authorities often prove to be effective program advocates, they tend to have a single focus, so that they may actually resist, and even oppose, development strategies and fiscal policies of general governments.[63]

Proposals for reducing intergovernmental tensions. Each state's pattern of state-local responsibilities is unique. About one-half the states have official state-local relations bodies that work to smooth state-local and interlocal relationships.[64] The ACIR recommends that all states should create and use such bodies.

Government reformers have proposed many ways to strengthen state roles in urban and economic development programs as well as ways to improve state-local relations. These include reducing the number of independent special purpose units and harnessing the rest to the broader objectives of general purpose governments. The response has been mixed at best.[65]

The number of independent special districts and authorities devoted to public works (and the amount they spend) continues to increase dramatically in every part of the nation despite many recommendations against their proliferation.[66] Although the rate of increase in the number of such units was slower in the

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[63] Institute of Public Administration, "The Role of Special Districts and Public Authorities in Public Works Provisions," prepared for the National Council on public Works Improvement, August 1987, pp. 9-11.

[64] Advisory Commission on Intergovernmental Relations (ACIR), *State-Local Relations Bodies* (Washington, DC: March 1981).

[65] See, for example, Advisory Commission on Intergovernmental Relations, *State and Local Roles in the Federal System* (Washington, DC: April 1982); Advisory Commission on Intergovernmental Relations, *The States and Distressed Communities* (Washington, DC: November 1985); and National Conference of State Legislatures, "Recommendations of the Task Force on State-Local Relations," October 20, 1986.

[66] Institute of Public Administration, op. cit., pp. 155-169; Advisory Commission on Intergovernmental Relations, *State and Local Roles in the Federal Systems* (Washington, DC: April 1982), pp. 253-256.

1977-82 period (15 percent) than in the 1972-77 period (37 percent), this is still the fastest growing kind of government in the nation.

The ACIR recommends state legislation to give general local governments the opportunity to review and approve special district projects within their borders.[67] Section 204 of the Federal Demonstration Cities and Metropolitan Development Act of 1966 requires general local government review and comment on the federal aid applications of special districts for physical development projects in metropolitan areas. Also, state-level ACIRs might help to smooth these relationships.

State aid to public works increased overall between 1978 and 1986, but at a slowed pace in 1983-86.[68] Increases in state gasoline taxes for highway programs have been significant; 42 states have done it since 1982.[69] Earmarking state or local option taxes for transit also is gaining favor. Increasing state aid to transit is approximately at the same annual level as decreasing federal aid ($3.5 billion). State creation of revolving loan funds for wastewater treatment is also increasing as a direct response to federal withdrawal. In addition, a few states offer financial assistance for public works through bond banks, loans, or grants.

On the other hand, state responses to public works have been far from uniform. According to a 1987 survey of state aid prepared for the National Council on Public Works Improvement by the Council of State Governments, only two states had explicit policies of replacing lost federal aid, and only five assume primary responsibility for public works (or are increasing their share of such responsibilities). This is reflected by the fact that about 80 percent of the state income tax windfalls created by the Tax Reform Act of 1986 have been returned to the taxpayers rather than retained to help refinance federal-aid cutbacks.[70]

In some states, state-aid cutbacks have coincided with federal cutbacks. At least 11 states view public works as primarily or exclusively a local responsibility and see federal cuts in those programs as a local issue. At least nine states have constitutional or legislative constraints impeding their ability to respond to federal cutbacks. Some states have increased local authority to meet infrastructure needs themselves; primary among these devices have been authority to create special assessment districts, to increase user fees, and to levy new local option taxes. Smooth state-local relations depend in large measure upon local governments having enough financial resources to meet the responsibilities assigned to them.

CONCLUSION

The role changes that have been proposed in studies prepared for the Council are fairly modest. They are evolutionary rather than revolutionary. Even if all were adopted, the nine categories of public works focused upon by the Council would remain intergovernmental. Some (such as water resources and waste disposal) are becoming more rather than less intergovernmental. Also, private sector involvement remains significant in several categories.

The challenge in sorting through these mixed responsibilities is to clarify the roles. If the roles are clear, authority and accountability can match responsibility. It is unlikely that such a clarification of roles will leave any major public works functions exclusively within a single level of government. Thus, intergovernmental relationships will continue to need attention.

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[67] Advisory Commission on Intergovernmental Relations, "Suggested State Legislative Program: Part 2," (Washington, DC: U.S. Government Printing Office, November 1975), pp. 114-117.

[68] The following information about state aid is drawn from Council of State Governments, "State Assistance for Local Public Works," prepared for the National Council on Public Works Improvement, August 1987, and Ledebur et al., "Changing State Roles in Public Works," prepared for the National Council on Public Works Improvement, September 11, 1987.

[69] Information supplied by the Highway Users Federation, January 22, 1988.

[70] W. John Moore, "Tax Reform Ripples," *National Journal*, September 12, 1987, p. 2270.

CHAPTER V

ENHANCING THE PERFORMANCE OF PUBLIC WORKS SYSTEMS[1]

The importance of measuring the performance of public works systems is a theme that runs through the preceding chapters. Such measures are necessary for gauging infrastructure needs more precisely, maintaining and expanding service capacity more effectively and efficiently, and supporting a growing and prospering economy.

This chapter suggests ways to use performance information to develop and manage public works in ways that will make the nation's infrastructure investments pay off more productively. It recognizes that public works performance must be improved within the cost constraints imposed by public budgets, user fees, and the nation's capital markets. To pursue cost-effective approaches we must:

- Base our decisions on performance goals and performance monitoring.
- Emphasize better maintenance.
- Reduce delays in siting, design, and construction.
- Speed innovation in technology and management.

We explore innovations in the next chapter; the other approaches are examined here.

MAKING DECISIONS BASED ON PERFORMANCE

Basing public works decisionmaking on the performance of infrastructure systems requires consideration of the following four topics:

- Performance goals.
- The decisions required to reach those goals and the decisionmakers responsible for making them.
- The performance data and analytical tools needed to support performance-based decisions.
- The means of encouraging and supporting the installation of performance-based information systems and decisionmaking processes.

These four interrelated topics are addressed next.

Public Works Performance Goals

Public works programs should help meet at least six basic objectives.[2] These include:

- To maintain appropriate levels and quality of service.
- To support economic development, employment, and fiscal policies.
- To distribute services equitably.
- To limit deferred maintenance liabilities.
- To synchronize public works services with the pace of land development, redevelopment, or diminishing use.
- To enhance the economic return on public works investments.

These objectives illustrate the broad scope of infrastructure policies that federal, state, and local officials confront regularly. Each is described briefly below.

1. *Maintaining appropriate service levels.* Local communities may establish service levels, and national or state standards may define minimally acceptable levels of service. Success in providing public works services can, in part, be measured by comparing actual levels (or projected levels) against established goals.
2. *Supporting economic development.* Infrastructure use is an essential ingredient of economic activity all

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[1] For a more detailed discussion of these issues see Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," prepared for the National Council on Public Works Improvement, August 11, 1987, and Deloitte Haskins and Sells, in association with Apogee Research, Inc., Berkeley Planning Associates, and CH2M Hill, "Final Report on Recommendations to Improve Public Works Decision-Making," prepared for the National Council on Public Works Improvement, November 1987.

[2] These types of public works goals were drawn largely from the following reports prepared for the Council: Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works;" Garn and Fosler, Economic Considerations in Infrastructure; Deloitte Haskins & Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making;" Hatry, "The Capital Investment and Maintenance Decision Process;" and Apogee Research, Inc., "Making More Efficient Use of Limited Public Revenues."

across the country.[3] Federal, state, and local officials all must determine how much and what type of public works capacity to provide; where to provide it; and when to provide it to support their economic goals.

Political considerations often influence expenditure decisions in different directions.[4] However, whether public facilities will be expanded in the hope of attracting economic activity, provided just in time to meet demands, or installed in an effort to catch up, economic development and public works are inevitably linked.

3. *Distributing services equitably.* Deciding where to spend public works dollars and which groups to benefit is an age-old political matter. However, the growing influence of objective analysis and standards for equitable treatment now vie with traditional lobbying to determine when, where, and how to invest in public works. Ways of accommodating these influences include funding formulas and targeting, regulations about the handicapped, the elderly, or the disadvantaged; criteria for considering alternatives; requirements for analyzing project benefits as well as costs; and environmental impact analysis. Mapping and reviewing performance data is one way to measure progress toward equity among geographic neighborhoods and jurisdictions and the diverse demographic groups that cluster there.
4. *Limiting deferred maintenance.* Many public works systems suffer from deferred maintenance; facility breakdowns or other interruptions become more frequent and the service quality deteriorates. This phenomenon, examined nationwide, led to the charge that America is in ruins or could soon reach that condition.[5] Regular maintenance can forestall such results. Analyzing failure rates, condition surveys, and maintenance costs can help in deciding what maintenance will be most effective. Many officials already use computer programs to schedule pavement maintenance;[6] such programs offer largely untapped potential in other fields.

   Scheduling effective maintenance can extend the life of facilities to, and perhaps even beyond, the design life of the facility at the least cost. The relationship of actual replacement to replacement needs is one rough way of gauging the extent to which deferred maintenance is being handled. The city of Milwaukee, for example, makes estimates of replacement rates every year, along with condition measurements and estimates of remaining useful life of facilities, to show whether deferred maintenance is growing or declining.[7]
5. *Synchronizing public works with development.* It is difficult to achieve an ideal balance between public works investment and private development. Planners have traditionally used such tools as the twenty-year comprehensive plan; zoning, subdivision, and mapped streets ordinances; the five-year capital improvements program; and the one-year capital budget. These tools frequently have not been equal to the task.

   For well over a decade, rapidly growing communities have been developing two supplemental methods to address this deficiency: (1) "adequate public facilities" or "staged growth" ordinances that slow private building when adequate public facilities are not available,[8] and (2) developer financing techniques that let the private sector help speed the provision of lagging public facilities.[9] There are many variations of these approaches; in some places they are linked together.

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[3] U.S. Department of Commerce, Office of Economic Affairs, "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services," prepared for the National Council on Public Works Improvement, July 30, 1987. See also Chapters I and II of this report.

[4] Harvey A. Garn and R. Scott Fosler, "Economic Considerations in Infrastructure Decision Making," prepared for The National Council on Public Works Improvement, September 25, 1987.

[5] Pat Choate and Susan Walter, *America in Ruins: Beyond the Public Works Pork Barrel* (Washington, DC: Council of State Planning Agencies, 1981).

[6] The American Public Works Association, "Good Practices in Public Works," prepared for The National Council on Public Works Improvement, August 18, 1987, pp. 42-48.

[7] City of Milwaukee, *The 1987-1992 Capital Improvements Program* (Milwaukee, 1987) p. 46.

[8] American Society of Planning Officials, *Constitutional Issues in Growth Management* (Chicago: 1977); Robert M. Winick, "Balancing Future Development and Transportation in a High Growth Area," *Compendium of Technical Papers*, Institute of Transportation Engineers, 55th Annual Meeting, August 1985, pp. 55-59.

6. *Enhancing economic return on investments.* "Return on investment" analyses for public works projects are not the same as those prepared for private business.[10] However, we can estimate the relative economic merits of infrastructure elements using such measures as productivity ratios, cost-effectiveness evaluation, benefit-cost ratios, and cost recovery ratios. These proxies for economic efficiency help in the difficult tasks of choosing among alternatives and ranking projects in priority order.

There are many different ways of meeting these performance goals. Each alternative has advantages and disadvantages that need to be carefully weighed. This evaluation process bears elaboration here because it is such a key factor in making the nation's infrastructure investments pay off more productively.

Analyzing Alternative Infrastructure Strategies for Achieving Goals

Council research suggests that applying the following principles can improve the efficiency, effectiveness, and equity of investments in public works:[11]

- Enhanced performance should be the combined goal of all public works activities (including operations, maintenance, and capital improvements).
- Projects should be selected from the widest feasible group of alternatives.
- All public works investment alternatives should be evaluated rigorously and consistently against performance goals and project selection criteria. Such alternatives should include opportunities for eliminating obsolete and uneconomic public works facilities.

To act on these principles, officials need to analyze alternatives designed to improve overall system performance by (1) stretching the capacity and life span of existing facilities, (2) reducing demand for new facilities by pricing and regulating, and (3) combining or eliminating systems, as necessary, for better efficiency. The following discussion examines performance-based approaches to analyzing such alternatives, as well as some of the barriers and risks associated with substituting low-cost alternatives for new capital investment.

Stretching capacity and life spans of existing facilities. Public works construction, operations, and maintenance should work together within budget constraints to help maximize infrastructure performance.[12] Timely maintenance reduces long-term maintenance costs and ensures the life expectancy of existing facilities and equipment.[13] Innovative operations can add capacity for little cost and can reduce maintenance needs (e.g., computerized traffic control systems and non-corrosive snow and ice melting compounds). New equipment or facilities can be designed for:

- Ease of operation (equipping transit buses with brake retarders for safer performance and less wear).
- Ease of maintenance (installing sensors in equipment and structures to provide continuous condition monitoring).
- Reduced maintenance (using easily removable microprocessor controllers in transit railcars).

In spite of the importance of good operations and maintenance to improved performance, federal funds have been most readily available for capital projects.[14] Moreover, the matching ratios for federal funds encourage capital investment instead of operations and maintenance expenditures. For example, until recently, the Water Pollution Control Act and its amendments favored construction-oriented wastewater treatment.[15] However, alternatives to plant construction are now being accepted. These include lower levels of treatment under certain circumstances, improved sewer lines that do not allow groundwater to infiltrate the system, and control of pollution sources other than sanitary sewers.

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[9] James E. Frank and Robert M. Rhodes, editors, *Development Exactions* (Chicago: American Planning Association, 1987). See also Michael Stegman, *Paying for Development* (Washington, DC: Urban Land Institute, 1986); "Symposium: Development Impact Fees," *Journal of American Planning Association*, Vol. 54, no. 1 (Winter 1988).

[10] For a recent example of the use of such efficiency measures to evaluate public works programs (the expected economic efficiency of the $12 billion air traffic control modernization plan), see Congressional Budget Office, *Improving the Air Traffic Control system: An Assessment of the National Airspace System Plan* (Washington, DC, August 1983). For an in-depth discussion of the limitations of rate-of-return analysis in public decision making, see Apogee Research, Inc., "Infrastructure Issues Problems and General Solutions," a report to the National Council on Public Works Improvement, October 1986. For additional discussion of project versus program efficiency and controlling for quality of service, see Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (Washington, DC, June 1985).

[11] Apogee Research, Inc., "Making More Efficient Use of Limited Public Resources," op. cit.

[12] Operations refers to the day-to-day delivery of services. It includes labor, engineering, and other support activities. Maintenance refers to routine inspection and repair of existing facilities and equipment. Operational changes can improve service and add capacity; better maintenance can help to extend the life of facilities and equipment.

[13] Apogee Research, Inc., "Maintaining Good Maintenance," prepared for the National Council on Public Works Improvement, September 1987.

Operational improvements can increase current capacity and improve performance. For example, the primary problem with airport and airway facilities is congestion. However, new runways may not be the only or most urgent answer; the most immediate solution may be the installation of equipment letting planes depart and land at closer intervals. Also, alternative pricing strategies, such as peak-load landing fees, have reduced congestion at all three major airports serving New York City.[16]

The Council sponsored Symposium on New Directions in Technology and Infrastructure concluded that the major opportunity for public works innovation in the next 20 years will be found in new techniques for operation, maintenance, and upgrading.[17] Current needs could be met by using new technologies to improve operations, to enhance performance, and to extend useful life; total replacement of America's current infrastructure would be prohibitively expensive.

Managing demand. Demand management can provide low cost alternatives to new capital investment. The Council's reports on hazardous waste[18] and solid waste[19] both recommend reducing the introduction of pollutants into the waste stream. Such a reduction would lessen the demand for waste disposal services and the need for greater landfill capacity.

Waste can be reduced by providing:

- Incentives to generate less solid waste.
- Subsidies and other inducements for recycling.
- Incentives for reusing recycled materials.

Although it may not be easy politically, state and local governments can promote waste reduction by setting goals and by making recycling more convenient. Certain states have established goals of recycling anywhere from 15 to 40 percent of the waste stream. Several states—including Oregon, Massachusetts, Maine, and Michigan—have implemented "bottle bills" that provide incentives for recycling glass bottles and metal cans. Massachusetts' 1983 bill is being followed up by building a series of material-recovery facilities throughout the state. The first facility was scheduled for operation in late 1987.

Regulations governing product packaging also can help reduce waste. Taxes on items that are difficult to dispose of (e.g., lead, zinc, or plastics) could reduce their use and provide funds to process them. Regulations requiring reuse of or deposits on recyclable items (e.g., automotive batteries or motor oil) serve the same purpose.

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[14] The Urban Institute, *The Nation's Public Works: Report on Mass Transit* (Washington, DC: National Council on Public Works Improvement, May 1987); and Apogee Research, Inc., *The Nation's Public Works: Report on Wastewater Management* (Washington, DC: National Council on Public Works Improvement, May 1987). See also Roger J. Vaughn, "Excerpts from 'Rebuilding America, Financing Public Works in the 1980s'" in *Civil Engineering*, American Society of Civil Engineers, September 1983, pp. 65-68.

[15] Gerald Bernstein, *Infrastructure Innovation and Technology*, SRI Business Intelligence Program Report No. 723, Summer, 1985.

[16] Apogee Research, Inc., *The Nation's Public Works: Report on Airports and Airways* (Washington, DC: National Council on Public Works Improvement, May 1987), p. 51-52. See also: Alan Carlin and R. E. Park, "Marginal Cost Pricing of Airport Runway Capacity," *The American Economic Review*, Vol. 60, (1970); Dayl Cohen and Amedeo Odoni, *A Survey of Approaches to the Airport Slot Allocation Problem* (Massachusetts Institute of Technology, May 1985); and Amedeo R. Odoni and Joseph F. Vittek, "Airport Quotas and Peak-Hour Pricing: Theory and Practice," (Massachusetts Institute of Technology, May 1976).

[17] New York University, Graduate School of Public Administration, Urban Research Center, *New Directions in Technology and Infrastructure*, draft report on a symposium held at the Harrison Conference Center, Glen Cove, New York, June 5-7, 1987, prepared for the National Council on Public Works Improvement, September 1987.

[18] Apogee Research, Inc., *The Nation's Public Works: Report on Hazardous Waste Management* (Washington, DC: National Council on Public Works Improvement, May 1987).

[19] R. W. Beck & Associates, *The Nation's Public Works: Report on Solid Waste* (Washington, DC: National Council on Public Works Improvement, May 1987).

Decommissioning and consolidation. When demand for infrastructure services declines, dilapidated or outmoded facilities may not need to be repaired or replaced. Rural road systems are especially vulnerable, particularly in farming communities where public revenues have not kept pace with increasing demands for maintenance. Recently, the Richland County, ND, board of supervisors reexamined its options for road maintenance. All things considered, the supervisors decided to reduce the road mileage and the number of bridges under county maintenance, to downgrade sections of the road network, and to apportion available funds by priority.[20] A recent study analyzed evaluation techniques that can be used by county road officials to determine whether or not certain rural roads should be downgraded or abandoned.[21]

Consolidating or regionalizing services is another way to maintain service while reducing costs. For example, regional water supply cooperation can include:

- Regional integration of water supply and wastewater treatment.
- Areawide water-supply management.
- Integration of private sector services by cooperation agreements, acquisition, or merger.
- Regional integration of all water resources management.[22]

Regional cooperation can mitigate the impact of federal and state regulations, can offer financial savings and can improve service delivery. Such benefits accrue from comprehensive management, improved planning and design, and increased economies of scale.[23]

Overcoming barriers to low-cost alternatives. Priority infrastructure problems can be solved through capital investment or by low-cost alternatives such as those discussed above. But despite the potential of these alternatives, certain barriers often keep officials from pursuing them.

Most federal programs promote expansion of public works facilities (rather than other means to improve services). For example, over $57 billion in federal spending to build or upgrade over 6,000 municipal wastewater treatment plants has been the centerpiece of the 1972 Clean Water Act. Although not fully effective, the investment has at least stopped the decline in water quality.[24] Currently, however, experts agree that controlling runoff from rain on farms and city streets may clean up some waterways more efficiently than building additional wastewater treatment plants.[25]

Evidence also shows that federal grant programs actually made replacing buses less costly to localities than maintaining them. UMTA has helped to rectify this by not allowing local transit authorities to replace buses until they reach a certain age.[26]

One key to using alternatives to capital spending is broadening the eligible uses of federal grants. For example, localities can now substitute mass transit (or other highway investments) for economically unjustifiable sections of the Interstate Highway System. Over 70 percent of the sections traded in for other investments would have yielded zero or negative traffic returns. This also concentrated federal Interstate spending on portions that will yield positive returns.[27]

Earmarked funds at other levels of government also may create barriers to cost-effective alternatives (see Chapter III).

Finally, public works programs seldom specify performance standards for facilities or equipment. However, using such standards (rather than design criteria) can increase the number of ways to meet program goals. The Clean Water Act originally awarded grants for treatment plants only if the plants could meet discharge standards based on capital-intensive designs. Over time, the program took account of high costs and broadened the criteria to allow more innovative technologies. By 1985, advanced treatment techniques had been found that cost approximately one-half as much as the EPA-approved technology.[28]

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[20] North Dakota Department of Transportation, Planning Division, "Richland County's Road and Bridge Network," March 1987.

[21] Iowa State University, *The Economics of Reducing the County Road System: Three Case Studies in Iowa* (Washington, DC: U.S. Department of Transportation, January 1986).

[22] Wade Miller Associates, Inc., *The Nation's Public Works: Report on Water Supply* (Washington, DC: National Council on Public Works Improvement, May 1987).

[23] Apogee Research, Inc., "Problems in Financing and Managing Smaller Public Works," prepared for the National Council on Public Works Improvement, September 10, 1987.

[24] Richard A. Smith, Richard B. Alexander, and M. Gordon Wolman, "Water Quality Trends in the Nation's Rivers," *Science*, Vol. 235, p. 1607 (March 27, 1987), as cited in Apogee Research. Apogee Research, Inc., "A Consolidated Performance Report," op. cit.

[25] Apogee Research, Inc., *The Nation's Public Works: Report on Wastewater Management* (Washington, DC: National Council on Public Works Improvement, May 1987), p. 18.

[26] U.S. Department of Transportation, Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions* (Washington, DC, June 1987), pp. 134-138.

[27] "National Consequences of Changing Investment Priorities in the Interstate Highway Program," (Washington, DC: Federal Highway Administration, 1981).

Considering risk assessment and management. When discussing low-cost alternatives, we must consider risk, particularly when the alternatives include innovative concepts or practices. As a result of court rulings against sovereign immunity for state and local government,[29] many public agencies have developed risk management programs.[30] Such programs emphasize consistency in design, construction, and operation. Manuals, standards, warrants, and policies that have been researched and codified by the engineering community frequently become standard practice guides for public agencies. Facilities must meet a concept of standard practice that is defensible in court.

This approach preempts many low-cost or service-oriented solutions in favor of capital-intensive improvements. In effect, tort law has become a regulator in public works.[31] This limits the range of available options. To help lower this barrier, we need further research, development, and demonstration of innovations.[32] Reforms in tort law also may be helpful in limiting punitive damages and distributing damage assessments equitably among responsible parties rather than assigning them exclusively or largely to the party most likely to be able to pay (which often is a public body).

In a somewhat different vein, the U.S. Environmental Protection Agency (EPA) recently has been recasting its entire program within a risk assessment and risk management framework.[33] With environmental pollutants viewed as risks to the American people and environment, EPA's tasks fall into two categories: (1) objectively assessing the levels and health risks of various pollutants, and (2) evaluating alternative means of reducing those levels and risks considering economic, technological, and legal factors. In the first category, scientific objectivity is paramount. In the second, political judgment plays a major role. EPA's attempt is to foster consistency among its many programs in using the best science and reasoned value judgments in an explicit risk management process to arrive at its regulatory and investment decisions. EPA seeks the following advantages from this approach:

- Risk management helps set priorities.
- Risk management provides a context for balanced analysis and decisionmaking.
- Risk management produces more efficient and consistent risk reduction policies.

Evaluating alternative investments consistently. The analytical key to better investment decisions is a system for evaluating the alternatives. Such a system would include:

- Comparable performance measures for assessing competing alternatives (including indicators of physical facilities, level of service, health and safety, and economic performance).
- Measurements of the durability of alternative structures and equipment.
- Assessment of risks and liabilities.
- Assessment of the potential for and consequences of miscalculating project costs and benefits.

Analytic techniques and information support for such decisionmaking are described in a later section. We turn now to an exploration of the types of decisions and decisionmakers involved in this approach.

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[28] Congressional Budget Office, *Efficient Investment in Wastewater Treatment Plants* (Washington, DC, June, 1985).

[29] John C. Pine, and Robert D. Bickel, *Tort Liability Today: A Guide for State and Local Governments* (Washington, DC: Public Risk and Insurance Management Association and the National League of Cities, 1986).

[30] George L. Head, *The Risk Management Process* (New York: Risk Management Publishing, Inc., 1978).

[31] Peter Huber, "The Bhopalization of American Tort Law," in *The Positive Sum Strategy: Harnessing Technology for Economic Growth* (Washington, DC: National Academy Press, 1986).

[32] Committee on Infrastructure Innovation, National Research Council, *Infrastructure for the 21st Century: Framework for a Research Agenda*, prepared for the National Council on Public Works Improvement (Washington, DC: National Academy Press, 1987).

[33] U.S. Council on Environmental Quality, *Environmental Quality 1984: The Fifteenth Annual Report of the Council on Environmental Quality* (Washington, DC: U.S. Government Printing Office), Chapter 4.

Linking Performance Goals to Decisions and Decisionmakers

Reaching public works performance goals requires a wide variety of decisions. They range from adopting broad plans and policies, to administering specific regulations, programs, and budgets, to establishing performance data monitoring systems (See Exhibit V-1).

Pursuing these decisions requires different types of expertise at each level of government. The responsible parties can be classed into three broad categories of decisionmakers:

- *Policymakers:* chief executives, council members, and legislators.
- *Managers:* project managers, program managers, section heads, and department heads.
- *Technical staff:* engineers, data systems personnel, planners, and budget and policy analysts.

The decisions in each category differ greatly but contribute distinctly to overall policy results. Ultimate public service outcomes occur as the result of many decisions made by all three classes of decisionmakers at all three levels of government pursuing their individual responsibilities and interacting with one another.

Exhibit V-2 illustrates the relationship between the decisionmakers and the types of decisions they make as they contribute to overall public service outcomes.

Three principal spheres of decisionmaking are of central concern in pursuing public works performance goals: (1) providing public works, (2) regulating development, and (3) sponsoring associated intergovernmental aid and regulation. Each of these spheres of activity involves all three types of decisionmakers, including elected and non-elected officials. Exhibit V-3 illustrates the roles of decisionmakers within these three activities in achieving public works performance goals. Infrastructure performance data can be useful to these decisionmakers by providing them with a common language to help them achieve common goals.

Public works providers. Public works departments and agencies, along with chief executives and legislative officials,

EXHIBIT V-1
PUBLIC WORKS PERFORMANCE GOALS
AND RELATED DECISIONS

	Performance Goals					
Necessary Decisions	Synchronize Public Works w/Development	Attain Established Levels of Service	Support Economic Develop & Fiscal Policies	Distribute Services Equitably	Limit Deferred Maintenance Liabilities	Enhance Economic Return on Investment
1. Adopt Development Plans & Fiscal Policies	X		X			X
2. Adopt Level of Service Stds	X		X			
3. Admin. Devel. Regs	X		X			X
4. Adopt Capital and Operating Budgets	X	X	X	X	X	X
5. Admin. Development Exactions	X	X				
6. Set User Fees	X	X		X		X
7. Regulate the Use of Public Facilities	X	X		X	X	X
8. Design, Construct, Operate and Maintain Public Facilities				X	X	X
9. Collect and Analyze Data	X	X	X	X	X	X

EXHIBIT V-2

TYPES OF PUBLIC WORKS DECISIONS AND DECISIONMAKERS

	Types of Decisionmakers		
Decision Types	*Policymakers* (chief executives, council members, legislators)	*Managers* (project managers, program managers, section heads, department heads)	*Technical Staff* (engineers, data systems personnel, planners, budget & policy analysts)
1. Adopt Development Plans and Fiscal Policies	L	S	S
2. Adopt Level of Service Standards	L	S	S
3. Admin. Develop. Regs.	L	S	S
4. Adopt Capital and Operating Budgets	L	S	S
5. Admin. Development Exactions	L	S	S
6. Set User Fees	L	S	S
7. Regulate the Use of Public Facilities	L	S	S
8. Design, Construct, Operate & Maintain Public Facilities		L	S
9. Collect & Analyze Data		L	S

Legend:
L = lead role
S = support role

EXHIBIT V-3

TYPICAL PUBLIC WORKS PERFORMANCE GOALS, SPHERES OF DECISIONMAKER ACTIVITY AND CHARACTERISTIC ROLES

	Spheres Of Decisionmaker Activity		
Performance Goals	Public Works Providers	Development Administrators	Associated Intergovernmental Aid and Regulatory Officials
1. Synchronizing public works with develop.	S	L*	–
2. Attaining desired service levels	L*	L*	S
3. Supporting economic development	S	L	–
4. Distributing public works benefits equitably	S		L
5. Limiting deferred maintenance	L		S
6. Enhancing economic return on investments	L	S	S

Legend:
Lead Role = L
Major Support Role = S
Minor or No Role = –

*Leadership for this goal is shared because its attainment is dependent upon regulation of development (demand) and provision of service (supply).

own, operate, and manage physical facilities. Public works of all kinds can be locally owned. State ownership is concentrated in highways, parks and forests, universities, prisons, hospitals, courts, and administrative offices. Occasionally, states own airports, water ports, or other specialized facilities. Federal ownership includes public lands, major water resources facilities, military installations, veterans hospitals and homes, post offices, federal offices, courts, and penitentiaries.

The chief responsibilities of these agencies and officials are to:

- Plan, design and construct capital projects efficiently and on schedule.
- Reduce demand, if possible, to help live within established spending limits.
- Operate existing facilities efficiently to help avoid construction of new facilities.
- Maintain existing facilities well to extend their lives as long as feasible.

Development regulators. City and county governments, along with planning commissions, planning and building departments, citizen groups and others, work together to establish and administer comprehensive land development plans as well as ordinances for zoning, subdivision regulation, building construction and occupancy regulation, and public facilities timing. They have a primary role in preparing capital improvement programs.

Because of their regulatory role, these organizations generally take the lead in synchronizing public works with development. Their land-use regulatory powers put them in a position to negotiate with developers under state law.

Development regulators at the county and municipal levels, however, have little jurisdiction over state and federal lands. The states themselves, and the federal government, have primary control over those territories. Acting through their executive, legislative, and judicial arms, they administer public lands, major installations, and public buildings. State and federal agents negotiate leases, land swaps and other public land agreements. Generally, these actions are subject only to review and comment by local governments.

A few states also exercise some land-use powers themselves (such as facility siting) or have significant review over local land-use authority.[34] Some of the states also exercise concurrent land-use powers with local governments in coastal and other critical areas.

At the federal level, there is significant review over state and local land use in coastal areas and, in turn, strong state and local influence over federal development in those areas.

Associated intergovernmental aid and regulatory officials. Seldom can officials at any single level of government provide public works or regulate development without assistance or intervention by officials at other levels of government. State and federal aid, the regulations that accompany aid programs, and interlocal transfers of funds are important tools for providing this assistance. In addition, state and federal regulations, independent of financial assistance programs, have major effects. Each of these external influences brings the decisions of an array of legislative, executive, and judicial officials from other levels of government to bear on decisions at hand.

For example, federal aid for infrastructure is established by Congress and the President, and administered by a variety of executive departments. It currently runs to $25 billion per year and is distributed among a wide variety of state and local governments where officials strive to use it to best advantage through their own decisionmaking processes.

State aid to local governments for public works is established by state legislators and governors and administered by a variety of executive departments. Like federal aid, it is substantial and it affects decisionmaking within a large number of recipient governments.

Public works funds transferred among local governments are allocated by local elected officials or by members of special district governing bodies.

Aside from the issue of whether the amount of intergovernmental aid is sufficient, these aid programs typically pursue objectives set by the decisionmakers of the government supplying the funds. Such objectives may include:

- Stimulating more public works activity.

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[34] John M. DeGrove, *Land Growth and Politics* (Chicago: American Planning Association, 1984).

- Encouraging cost-effectiveness for assisted services.
- Establishing public activity in new public works fields (such as hazardous waste).
- Building greater policy, administrative, managerial, or technical capacity in the aided governments.

Progress toward such goals cannot be measured without performance data.

In addition to the external influences of decisions made by officials responsible for intergovernmental aid programs, there are significant influences by state and federal regulators. For example, federal environmental regulations (particularly those covering wastewater, air quality, and solid and hazardous wastes) heavily influence state and local public works decisions. Parallel state programs often affect the local decisions. Frequently, state and federal regulations are combined with aid programs, superimposing multiple layers of influence by external decisionmakers.

Conclusion. Council research indicates that all three basic groups of decisionmakers should reinforce one another in a coordinated effort to improve the nation's infrastructure. Although they play diverse roles, they share a common purpose. Consistent and reliable performance data could help not only to unify them, but to make each group more effective in its own right.

Information and Analysis for Making Better Public Works Decisions

Council research indicates that improved performance information would encourage more informed public works decisions in two ways. It would allow decisions to be based directly on (1) service adequacy relative to service demand, and (2) the most cost-effective service delivery alternatives.

Service adequacy measures include:

- The population served.
- Actual use versus available capacity.
- Compliance with established service standards.
- Frequency of delays, overcrowding, accidents, breakdowns, or other interruptions to service.
- The frequency of health and safety incidents.
- Actual economic and social benefits compared with expected benefits.

These performance measures supplement traditional data (such as the extent, value and condition of facilities and equipment) in important ways. Although traditional data help officials maintain facilities in accordance with engineering standards, they offer little advice about service adequacy. They do not show whether more facilities are needed or if different facilities would be more effective. Traditional data alone are not adequate for setting spending priorities and exploring low-cost service delivery alternatives.

Cost-effectiveness measures include:

- Unit costs of providing services.
- Service benefits in relation to their costs.
- The rate of facility and equipment replacement versus expected remaining life.
- The extent to which costs are being recaptured from users and other identified beneficiaries.

These measures can supplement traditional spending data (such as current spending in relation to past spending). They can provide more precise information about the productivity and return-on-investment expected of alternative projects and programs. Public works officials can use this information to assess such things as the trade-offs between improved operations, better maintenance, new equipment, and additional construction.

Performance measures like these, when consistently available statewide or nationwide, can be aggregated and summarized to help officials at each level of government develop and fund more effective intergovernmental public works programs. However, information based on public works performance and related analyses generally are not available to support public works decisionmaking.[35]

Analytic Techniques. Various analytic techniques can support performance-based evaluation (see Exhibit V-4). These can be classified as follows:

- *Descriptive:* inventories and data bases storing information about the physical, social, and economic environment, such as air and water quality, and population, and public

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[35] For example, see: George Peterson, et al, "Infrastructure Needs Studies: A Critique," prepared for the National Council on Public Works Improvement, October 1986; Harry P. Hatry, et al, "The Capital Investment & Maintenance Decision Process in the Public Sector," prepared for the National Council on Public Works Improvement, October 1986; Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," prepared For The National Council on Public Works Improvement, August 1987; Deloitte Haskins and Sells, "Final Report on Recommendations to Improve Public Works Decision-Making," prepared for The National Council on Public Works Improvement, November 1987.

EXHIBIT V-4

REPRESENTATIVE ANALYTICAL TECHNIQUES FOR SUPPORTING PUBLIC WORKS DECISIONMAKING

CLASSIFICATION	PURPOSE	TECHNIQUES
Inventory systems	Maintain current descriptive information	Attribute databases Condition/deficiency index systems Service levels/standards databases Maintenance history/cost data Geo-based mapping systems
Management models and systems	Assist in project design and construction, operation and maintenance of current assets, and evaluation of project and program performance	Infrastructure asset management systems Maintenance management systems Quality control models Computer-aided design and drafting systems Risk-Safety analysis Value engineering models Repair/replace models Cost accounting systems Bond analysis systems Budgetary models Parts and supplies control systems Equipment management systems Project management systems
Policy models	Assist in developing long-term program strategies (using performance goals and related project selection criteria)	Benefit-cost analysis Life cycle cost analysis Fiscal impact models —socio-economic analysis —growth-tracking systems Environmental analysis Capital improvement programming systems Forecasting models

Source: Adapted from Deloitte, Haskins and Sells, et al. *Final Report on Recommendations to Improve Public Works Decision-Making*, prepared for the National Council on Public Works Improvement, November 1987.

works assets (listings of assets, maintenance histories, and so on).

- *Management:* techniques to help public works managers design and build projects, operate and maintain current assets, and evaluate project performance (based on identified goals and criteria).
- *Policy:* techniques to assess long-term performance of public works programs and make decisions for the future (using performance goals and related project selection criteria).

Some governments are using these techniques to make project and program decisions. Microcomputers with software tailored for public works support this trend.

Properly analyzed public works performance information is crucial to policy decisions. Such information can:

- Help public works managers make better daily operating decisions.
- Help public works policymakers develop improved future programs.
- Help program officials justify program changes to top executives, legislators and the general public.

For example, performance data can help managers measure a facility's current operating performance. In a recent study, the Amsterdam Airport was compared to other European airports on the basis of seven revenue indicators and ten expense indicators (see Exhibit V-5).[36] By comparing Amsterdam's performance against the indexed average of the other airports, managers could pinpoint

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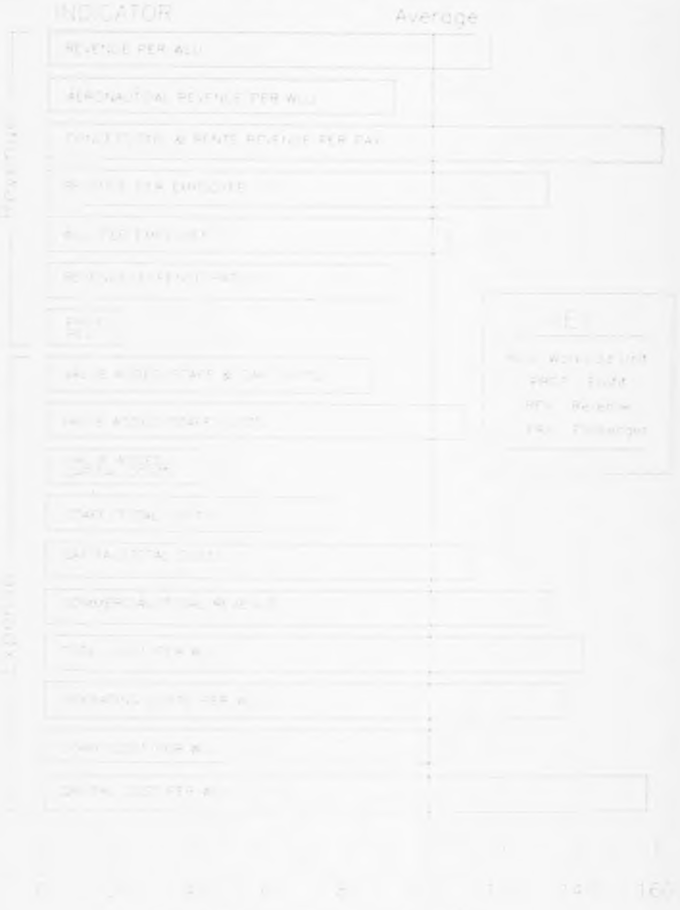
[36] David Woolley, *Airport Forum*, Nov. 2, 1987, as cited in Apogee Research, Inc., "A Consolidated Performance Report," op. cit., p. 32.

EXHIBIT V-5

PERFORMANCE INDICATORS FOR THE AMSTERDAM AIRPORT ACOMPARED TO EUROPEAN SYSTEM-WIDE AVERAGES



SOURCE: David Worley, Airport Forum, Nov 2, [illegible] shortfalls in operating procedures or investment needs and devise means for improvement.

The recent Rail Modernization Study prepared for the Urban Mass Transportation Administration (UMTA) provides an example of improved future-program decisions. Initially, an asset inventory and evaluation had determined that $17.8 billion would be required to upgrade and modernize U.S. urban rail transit systems. A further evaluation based on cost and quality of service showed that 8584 percent of the total passenger miles could be restored to good condition and that 69 percent of the net service quality benefits could be obtained at half the original study's suggested cost.[37]

In another example, a proposed change in the configuration of the Dayton, Ohio, trolley bus system was met with initial resistance by some transit board members and a vocal minority of the general public. However, an analysis based on service delivery, operating performance, and cost data showed that reducing the extent of trolley bus service (while continuing the motor coach service) could achieve significant savings in operations and maintenance costs without harming service.[38]

Principles for collecting and sharing performance data. Council research determined that despite the different backgrounds of public works decisionmakers, the data and analytical techniques they need at all levels are remarkably similar. As much as 70 percent of the data could be shared.[39] Moreover, the value of performance-based information depends on a regular schedule of reports to managers, elected officials, and the public.[40] For example, facility managers may need daily reports. Elected officials and citizens can monitor progress on the basis of monthly or quarterly performance reports. Annual reports showing multi-year trends and projections provide elected officials and top executives useful information for preparing capital investment plans and programs.

The following guidelines for improving the collection and use of performance data emerged from the Council's research:[41]

- It is important to measure all kinds of performance, not just physical assets.
- Data should be consistent in units of measurement and in geographic units.
- The source of data must be the system operator.
- Data will be more accurate if they are useful to the system operator and are not so voluminous as to discourage updating.
- National, state, or regional cooperation to set data standards will promote consistency, unified analyses, and broad dissemination.

Performance data should be automated to facilitate updating, analysis, presentation, and sharing. Rapid advances in information science present an unprecedented opportunity to achieve those goals. Studies of specific public works agencies show that investments in automated data systems often pay back in less than four years.[42]

Barriers to performance monitoring. Local performance data too often are not regularly collected and used. Those public works managers who do use performance monitoring to manage their own systems, seldom are able to compare their performance with that of other systems.[43] As a result, they may not be aware of alternatives which could help their systems perform better.[44]

The extent and quality of performance monitoring varies greatly. Almost without exception, however, the greatest weaknesses lie in the data available to measure service quality and cost-effectiveness. Measures of quality are not well defined and data collection is costly; many decisionmakers do not request detailed data about alternatives. They and their constituencies seldom question staff recommendations. In fact, Council research has identified certain barriers to the acceptance of performance monitoring.[45] These include:

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[37] Gannett Fleming Transportation Engineers, Inc., et al., *Rail Modernization Study-Final Report* (Washington, DC: Urban Mass Transportation Administration, Office of Grants Management, April 1987).

[38] Daniel Dunoyer and Walter Diewald, "Trolley Bus and Motor Coach Operational Cost Comparisons Utilizing Section 15 Data," a paper presented at the 67th Annual Meeting of the Transportation Research Board, January 1988.

[39] Deloitte, Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., p. 10.

[40] Ibid., p. 14.

[41] Apogee Research, Inc., "A Consolidated Performance Report," op. cit., p. 35.

[42] Deloitte, Hawkins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., p. 58.

[43] Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions* (Washington, DC: June 1987), p. 191.

[44] This is more characteristic of small public works systems for larger ones. See Apogee Research, Inc. and Wade Miller Associates, "Problems in Financing and Managing Smaller Public Works," prepared for the National Council on Public Works Improvement, September 10, 1987, pp. 86-88.

- The lack of valid comparative data and the difficulty of agreeing upon consistent standards for data collection.
- The unfamiliarity with new techniques.
- The need for new skills in public agencies to use these new capabilities effectively.
- The cost of new information systems.
- Finally (and perhaps most significantly) the time and expense required to establish and maintain the new data bases.

The first three are skills-related barriers, while the latter two are financial constraints. Using performance information depends on overcoming these barriers.

Encouraging Performance-Based Decisions

The best incentive for collecting and maintaining performance data is to have immediate and important uses for it. The next best is to be required or paid to do it.

Two important uses for performance data have emerged from Council research. One is to enhance the capital budgeting process, and the other is to organize more effective and highly accountable performance centers.

Capital budgeting. State and local public works planners have used capital budgeting over half a century. It ties comprehensive development plans to investment strategies, approval of individual projects, appropriation of funds, and the issuance of debt.

The major deficiencies of capital budgeting are lack of criteria for judging the relative worth and priority of projects, lack of comprehensiveness, and the separation of construction from operations and maintenance.[46]

Performance information can help improve capital budgeting by supporting program- and project-level evaluations. Such evaluations can provide objective criteria in the budget process. The National Conference of State Legislatures recently recommended that "the development and use of explicit criteria for reviewing capital budget requests should be an essential part of the legislature's capital review process."[47] Projects can then be selected on the basis of need and efficiency rather than for their "pork value."

The chief obstacle to comprehensiveness in local capital budgeting is the overlapping of many jurisdictions in the same geographic area (cities, counties, and special districts).[48] At the state level, this problem arises from the common practice of excluding projects funded through federal grants, dedicated revenues, or allocations to independent units. At the federal level, several agencies work on capital projects in the same public works category without cross-agency programming. Sharing program information among the many units can help improve intergovernmental coordination of interrelated systems.

Finally, with respect to the separation of construction from operation and maintenance, decisionmakers and operating agencies seldom consider maintenance and rehabilitation as alternatives to new construction. Examination of all the options, using performance data, could help capital improvement programs tie in with current expense budgets and avoid a capital bias.

The potential of performance centers. Clear visibility of public works programs has the advantage of creating public awareness of services, of their costs, and of the link between costs and performance. This has the effect of transforming public services into consumer commodities. In many cases, these can be priced more realistically. For example, when sewer services are charged on the water bill, the price can be related to the amount of water used, and a larger recovery of costs often can be achieved than when sewer service is billed separately at a flat rate.[49]

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[45] Deloitte Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., pp. 47-50.

[46] Harry P. Hatry, et al., "The Capital Investment and Maintenance Decision Process in the Public Sector," prepared for the National Council on Public Works Improvement, July 1, 1986, pp. 59-61.

[47] Barbara Yondorf and Barbara Puls, *Capital Budgeting and Finance: The Legislative Role* (Washington, DC: National Council of State Legislatives, November 1987), p. 59.

[48] Harvey A. Garn and R. Scott Fosler, "Economic Considerations in Infrastructure Decision-Making," prepared for the National Council on Public Works Improvement, September 25, 1987, pp. 8-9.

Council research suggests that organizing public works programs as visible performance centers can be desirable, especially in the present fiscal environment. The purpose of such centers would be to isolate all their costs and benefits, and seek to recover at least a substantial share of the costs from the various classes of beneficiaries. The centers can also provide superior management data and use it to improve performance in a more focused and publicly accountable way.[50]

Special districts and authorities are examples of performance centers that are particularly useful where services must be provided across local jurisdictions and state lines, or where local taxing or borrowing limits leave no alternative. However, special taxing areas administered by cities or counties, or other programs funded by dedicated revenues, also can operate as visible performance centers. These entities can then link costs more closely to benefits without the danger of too much independence sometimes exhibited by special districts and authorities.[51]

Intergovernmental incentives for performance monitoring. The federal government provides funding for public works built and operated by state and local governments. Thus, it is important that federal, state and local programs be coordinated to achieve national goals. Performance monitoring is an essential link in achieving this goal. It can be promoted by the following:[52]

- A coordinated and cooperative national program of technical assistance.
- Data collection requirements within public works programs.
- Financial incentives for using performance monitoring programs.

Some elements of such an effort are already in place. The foremost example is the federal-aid highway program. For many years, 1.5 percent of the funds for this program has been dedicated to research and planning. Much of that money has gone for data collection. In recent years, the fund has paid for data to support the biennial report to the Congress by the Federal Highway Administration *(The Status of the Nation's Highways: Conditions and Performance)*.[53] The information is generated through the cooperatively established Highway Performance Monitoring System (HPMS).

Section 15 of the Urban Mass Transportation Act also requires extensive performance reporting by transit operators as a prerequisite for federal funding. UMTA provides planning assistance grants that help defray the expense. However, serious problems with the quality of the data and the heavy burden of the requirement led to a four-year cooperative reevaluation with the transit industry. The result was a substantial streamlining of the reporting system that is expected to improve data quality and reduce the burden of collection.[54]

The biennial wastewater needs survey submitted to Congress by the EPA is also based on a cooperative data system.[55] The data are supplied by states with the assistance of federal planning grants.

A more comprehensive and consistent system of performance reporting could evolve from these beginnings. Such a system should draw upon cooperatively set data collection and reporting standards. Federal requirements, funding, and technical assistance have already provided incentives to improve the current data systems. Council research suggests that such incentives could continue to improve national performance monitoring.[56]

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[49] Apogee Research, Inc., *The Nation's Public Works: Report on Wastewater Management*, op. cit., pp. 110-111.

[50] For a discussion of data reporting to enhance public accountability, see Deloitte, Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., pp. 58-60.

[51] The Advisory Commission on Intergovernmental Relations recommends that counties establish subordinate taxing areas to provide special services needed in only part of the county. See *ACIR State Legislative Program. Part 2: Local Government Modernization* (Washington, DC: U.S. Government Printing Office, November 1975), pp. 84-86.

[52] Additional discussion of these options may be found in: Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," op. cit., pp. 35-38. See also Deloitte Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., pp. 60-62.

[53] U.S. Congress, *Report of the Secretary of Transportation to the United States Congress* (Washington, DC: U.S. Government Printing Office, June 1987), Committee Print 100-11.

[54] Joel Markowitz and Tom Rubin, "Revising the Federal Reporting System: Recommendations of the APTA Section 15 Committee," a paper presented to the APTA Eastern Training Conference, Ottawa, Canada, May 1987.

[55] Apogee Research, Inc., *The Nation's Public Works: Report on Wastewater Management*, op. cit., p. 21.

EMPHASIZING BETTER MAINTENANCE

This section examines the importance of maintenance, why it is often deferred, and options for improving it.

Importance of Maintenance

The maintenance of public works facilities has a major impact on the delivery of service, and consumes a significant share of public works expenditures. Maintenance spending amounted to about $28.4 billion in 1984, about 29 percent of all public works spending. Local governments provided the bulk of maintenance spending, about $19.2 billion or 68 percent.[57] Maintenance spending varies considerably because it depends on the characteristics of each category (facility and equipment age, use, and history of maintenance and rehabilitation actions). It also depends on the level of available funding.

Maintenance is Vulnerable

Lack of visibility. Maintenance spending does not generate the excitement associated with new capital projects. The public is seldom aware of maintenance unless a pothole persists or a bus air conditioner breaks down.

Along with being invisible, maintenance is not politically compelling. Decisionmakers seldom take strong positions; there is too little political demand for maintenance. Also, few public officials have had to face the task of recapitalizing existing facilities (the most notable recent exception being the New York City subway system). Generally, as communities have grown and expanded, it has been possible to generate interest in new facilities in the name of growing demand, new technology, or new federal grant programs. Mature communities face difficulties in financing replacement of aging facilities if their tax base and demand for public works is level or declining.

Operation and maintenance budgets are often easy to cut because voters do not see infrastructure deterioration. Even public officials who understand that breakdown maintenance is eventually more costly than preventive maintenance are often forced to defer maintenance because of competition from other priorities.[58] Ultimately, delay and postponement of maintenance result in the need for premature rehabilitation, rebuilding, or replacement.

Council research shows that neither policymakers nor constituents demand analyses of the impact of deferred maintenance, of alternative repair or replacement strategies, or of costs and benefits.[59]

Lags in applying new ideas. Engineering curricula and related public works education programs rarely include maintenance, although professional associations and federal agencies offer organized information-sharing on methods and techniques, diffusions and actual use of new ideas is limited.[60]

Nevertheless, research on maintenance management techniques and procedures has provided some useful results. For example, UMTA has reported on the application of work methods to bus maintenance that reduced maintenance costs by 30 to 50 percent.[61]

The principles of design for reliability and ease of maintenance, which are widely recognized as important to the proper functioning of highly complex equipment such as aircraft, are being applied to public works equipment as well.[62] Cost analyses have shown that improvements in railcar design can yield significant cost savings.[63]

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[56] Deloitte, Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., pp. 46-47. See also Apogee Research, Inc., "A Consolidated Performance Report," op. cit., and Apogee Research, Inc., "Making More Efficient Use of Limited Public Resources," op. cit.

[57] Apogee Research, Inc., "Maintaining Good Maintenance," op. cit.

[58] Breakdown maintenance and unscheduled maintenance are often used interchangeably. Breakdown maintenance specifically refers to unscheduled maintenance which is performed after the system or component has failed.

[59] Deloitte, Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit., pp. 25-26.

[60] *Ibid.*, pp. 34-39.

[61] UMTA. Maintenance Tools for Bus Maintenance.

[62] F. Stanley Nowlan, and Howard F. Heap, *Reliability-Centered Maintenance*. (Washington, DC: Office of the Assistant Secretary of Defense for Manpower, Reserve Affairs, and Logistics, Department of Defense, 1978).

[63] Walter Diewald and Donatus Muotoh, *Rapid Transit Car Maintenance and Overhaul Analysis*. (Washington, DC: May 1985).

Alternative maintenance approaches that have been developed in other fields are also applicable to public works. Studies have examined better ways to plan and organize maintenance tasks to reduce costs. For example, failure rate statistics can be extracted from standard transit maintenance records to provide operators with an accurate comparison of fixed-interval component replacement with failure or inspection-based maintenance.[64]

Equipment-monitoring techniques and management information systems can provide data bases for analysis. For example, a group spearheaded by large wastewater utilities created the Instrument Testing Service (ITS) in 1986. The ITS has conducted field tests on several instruments; an expanded test program is planned, including tests on a group of dissolved oxygen analyzers. The potential of these devices to reduce maintenance costs provided the impetus for the program.[65]

Options for Improving Maintenance

All the Council's studies of individual public works categories have emphasized the importance of maintenance. Public works professionals universally agree that inadequate and deferred maintenance can lead to costly equipment failures and shorter equipment lives. Nevertheless, performance-based measures for improving maintenance have been neglected.

Pavement maintenance management systems (PMMS) are a notable exception.[66] These systems enable managers to access an inventory of consistent and comprehensive data on pavement conditions. The PMMS program typically generates reports for pavement inventory, condition rating, and maintenance and repair requirements.

A PMMS can provide an agency with a basis for rational decisions regarding repair and rehabilitation of roads and streets. Information routinely available from a PMMS can provide managers with a way to schedule repair and avoid losses due to failure maintenance.

PMMS applications have also proven valuable for condition analysis, maintenance strategy, and life-cycle cost analysis. A disadvantage of the PMMS, which is shared by nearly all inventory data systems, is that it is time-consuming to set up the data bases.

Giving maintenance greater visibility. For public works maintenance to have greater visibility, public works decision-makers must have greater accountability. Improved accountability will be both a result of and a contributor to improved performance measurement.

Removing restrictions on funds. Restrictions in public works grants could be modified. For example, in block grants the separations between capital, operations, and maintenance are removed or deemphasized. If the separations are not removed, percentage relationships at least can be established, monitored, and adjusted periodically as needs change.

Establishing set-asides. Reserve funds for maintenance and sinking funds for replacement are frequently established when revenue bonds fund public works. That practice could be used more widely. In addition, certain percentages of public works budgets and grants are sometimes set aside for maintenance; these can be adjusted to improve the state of repair of particular systems.

Creating incentives. Requirements for federal and state assistance can be revised to include greater commitment to maintenance and rehabilitation. Such requirements could stipulate maintenance performance standards, and could call for maintenance plans, sound maintenance practices, and periodic maintenance audits.

Design for maintenance. Equipment design or facility construction does not always take maintenance requirements into consideration.[67] Maintenance managers are not usually consulted in the development of specifications for equipment for which they will be responsible. A change in this approach can yield significant cost savings.[68]

Summary. Suggestions for improving the maintenance situation include dedicating a portion of capital grant funds to maintenance, establishing sinking funds for maintenance, and setting inentives for maintenance. Together with better design and visibility for maintenance deficiencies, these measures could ensure significant improvements.

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[64] James Foerster, et al. *Maintenance Tools for Bus Maintenance* (Washington, DC: Urban Mass Transportation Administration University Research and Training Program, May 1983).

[65] Wade Miller Associates, Inc., *The Nation's Public Works: Report on Water Supply*, op. cit., p. 58.

[66] American Public Works Association, "Good Practices in Public Works," prepared for the National Council on Public Works Improvement, August 18, 1987, pp. 42-48.

[67] James M. Montgomery Consulting Engineers, Inc., *Water Treatment: Principles and Design* (1985), Chapter 24.

[68] Robert Contino, "Employee Participation: The Blue Collar Edge," *Public Works*, June 1987, pp. 81-82.

ALLEVIATING MAJOR PUBLIC WORKS DELAYS

A common complaint concerns the increasing amount of time required for major public works projects to be planned, authorized, and built.[69] The reasons for this include:

- Growing difficulty in siting certain facilities in populous areas.
- An increasingly complex contracting process, with set-asides for certain classes of contractors and complex safeguards against abuses.
- Increasingly complex projects, requiring sophisticated project management techniques.

A generation ago, it took only two or three years to get many major public works projects underway. Now, it may take fifteen years for similar projects. Such delays are expensive; in many cases, they completely foreclose projects because of inflated costs or other developments.

There are no easy solutions to the problem of delay. However, Council research suggests potential for easing siting and project-impact concerns through focusing responsibilities, clarifying accountability, establishing deadlines for required reviews, and using increasingly well developed techniques for preventing and resolving disputes.[70] Computerized project design and management techniques also can help keep authorized projects on schedule.[71] In addition, research by the Advisory Commission on Intergovernmental Relations suggests that there is potential to review federal mandates for simplification and streamlining without compromising the intent of those requirements.[72]

CONCLUSION

Clearly defined public works goals with measurable performance objectives would serve decisionmakers at every level of government well. A national performance monitoring system could provide all public works professionals with a common language.

Such monitoring could also bring a new degree of visibility and accountability to public works management—management that will be crucial in addressing the nation's future public works concerns.

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[69] For example, unpublished transcript of Boston hearing by the Council, August 3, 1987. Statement by Jim Sullivan, Chairman, Greater Boston Chamber of Commerce, p. 35.

[70] Rivkin Associates, "Review Paper on the Accommodation of Diverse Views in the Public Works Improvement Process," prepared for the National Council on Public Works Improvement, July 1987.

[71] Deloitte Haskins and Sells, et al., "Final Report on Recommendations to Improve Public Works Decision-Making," op. cit. pp. 28-34, B2, and B5. For additional considerations in avoiding delays in the design and construction of public works see: T. F. Como, J. D. Borcherding, and R. L. Tucker., *Engineering Design Delay Survey.* (Austin, Texas: The University of Texas at Austin, Construction Industry Institute, August 1983); and David F. Rogge, *Foreman-Delay Surveys for Construction Sites.* (Austin, Texas: The University of Texas at Austin, Department of Civil Engineering, December 1981).

[72] Advisory Commission on Intergovernmental Relations, *Regulatory Federalism: Policy, Process, Impact and Reform. (Washington, DC: February 1984), pp. 295-301.*

CHAPTER VI

ACCELERATING INNOVATION IN PUBLIC WORKS

The nation has seen rapid innovation in many fields—such as medicine, communications, and biotechnology—and of many kinds—technology, management, and operations—over the past 15 years. However the pace of discovery and technological breakthroughs for public works has been much slower and less dramatic.

Nevertheless, our expectations for innovation in public works are high because of the potential for improved performance and cost-savings. Research and development (R&D) has already yielded significant technological advances in infrastructure, but they are relatively few and are not often known to the general public. Examples include:

- Accurate, high-speed tunnel boring machines.
- In-place relining of water and sewer pipes.
- Low-cost and effective biological waste treatment systems.

These and many other developments have improved the performance of the infrastructure and reduced the cost of service delivery. Continuing the search for and encouraging the use of innovation are important components of an effort to improve performance. Equally important is the need for more information about long-term costs and the expected useful life of innovative solutions. Unfortunately, innovation sometimes faces barriers both in development and in use.

BARRIERS TO INNOVATION

The search for public works innovation has been hampered by two characteristics of our infrastructure system: industry fragmentation and the absence of a profit motive. Fragmentation results because no single government agency or organization is responsible for the state of a particular category of public works (such as highways). Fragmentation, disagreement among public works constituencies, and competition among public works categories for scarce resources, have combined to prevent a coordinated R&D effort.[1]

Also, the profit motive, which often drives private sector research, is not a major factor in public works. Although R&D provides a cost-savings potential, funds are limited and the benefits are often too uncertain for a public agency to undertake the research. Private industry has yet to find public works a highly profitable market, primarily because fragmentation of the industry prevents large-volume production and sales.

Other barriers confront successful R&D products, slowing the spread of innovation. For example:

- *Cultural patterns:* Public unwillingness to change personal habits can prevent new technology from being accepted, effective, or efficient. The reluctance in many communities to support bottle bills and the difficulty of getting commuters out of their cars and into transit are well-known examples.
- *Governmental or professional standards:* There is strong institutional and social reluctance to change accepted standards, codes, and practices in order to accommodate innovation.
- *Risk and liability:* Fear of financial liability forces decisionmakers and managers into a conservative approach to design and construction; this can prevent the consideration of innovative ideas and solutions.
- *Organizational inertia:* Turf problems and pressure to maintain the status quo can present serious obstacles to innovation.

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[1] American Water Works Association Research Foundation, "A Definitive Study of Barriers to the Introduction of New Products and Technologies into Water Supply Systems" July, 1985, as cited in Wade Miller Associates, Inc., *The Nation's Public Works: Report on Water Supply* (Washington, DC: National Council on Public Works Improvement, May 1987).

- *Availability of resources:* Research, development, and initial implementation of new technology is often very expensive; this compounds the problems facing innovation.

Nevertheless, certain factors can make innovation more attractive and help overcome these barriers. For example:[2]

- *Compatibility with existing investments:* If new technology does not make past or current investments obsolete, it is far more attractive.
- *Compatibility with existing institutional arrangements:* An innovation that does not conflict with the culture of the organization will find easier acceptance.
- *Compatibility with existing behavior:* If people can continue in their habits, the more likely it is that they will accept new technology.
- *Constituency support:* If an "insider" group supports the innovation, it will have a much better chance for success.

Barriers to innovation are not unique to public works; however, evidence suggests that they are formidable. A successful national effort to encourage infrastructure R&D must address these barriers and develop the means to overcome them.

ENCOURAGING INNOVATION

Further technological innovation in public works could reap rich rewards in service improvement and cost-savings. Congress has recognized this potential by funding the Strategic Highway Research Program (SHRP). The SHRP program aims at improving pavement and bridge materials and components through a program of short-term, high-payoff research.[3] The rationale is simple. The total cost of rehabilitating and replacing the nation's highways will be between $1 trillion and $3 trillion. Therefore, an improvement of just 1 percent in the performance and durability of our roads and bridges would yield direct savings of between $10 and $30 billion.

Data from the California Department of Transportation provides further evidence of the value of R&D. The department attributes dollars saved to specific research projects on a three-year basis. When compared with research costs for nineteen three-year periods, the ratio of savings to costs ranges from 2.8 to 5.4.[4] (See Exhibit VI-1.)

Necessity can enhance the value of R&D. The legislation and concomitant regulations of the Safe Drinking Water Act identify 83 contaminants in drinking water that will require monitoring and removal. EPA data on these are not complete; considerable research will be necessary to substantiate the importance of these contaminants and to determine how best to monitor and control them in the most cost-effective manner.[5] Thus, there is a real need for research to keep up with the demands of federal public works legislation and regulations.

POTENTIAL TOPICS FOR RESEARCH AND DEVELOPMENT

The category studies commissioned by the Council identified many areas where innovation in infrastructure could lead to improved quality of service, improved performance, and reduced costs. The European infrastructure approach strongly parallels the R&D direction suggested here. Foreign countries often focus on improvements in efficiency and cost-effectiveness and on the concerns of maintenance and rehabilitation.[6] A study by the Committee for Infrastructure Innovation of the National Research Council (NRC) separated the promising areas for innovation into four groups:

- Improvement of existing systems through new technology or operating methods.
- Improved maintenance of existing systems through such techniques as performance monitoring and failure detection.

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[2] Draft proceedings, *Symposium on New Directions in Technology and Infrastructure*, Harrison Conference Center, June 5-7, 1987, Glen Cove, New York.

[3] Transportation Research Board, National Research Council, *America's Highways—Accelerating the Search for Innovation*, (Washington, D.C.: 1984), Special Report 202.

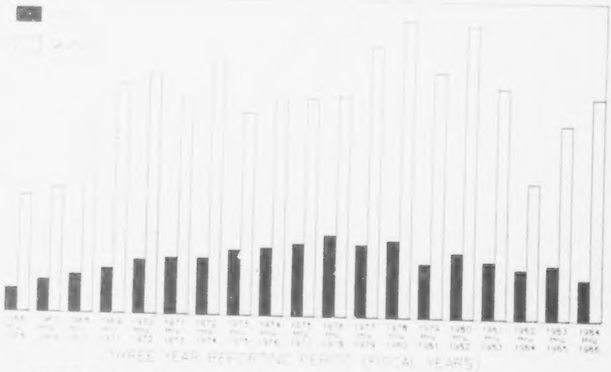
[4] California Department of Transportation, "Report of Facility Research Accomplishments," (February 1987), Report No. 23.

[5] EPA officials reported to the Advisory Committee of the National Council on Public Works Improvement on January 15, 1988, that the expected cost to water-suppliers of meeting the new standards would be about $5 billion.

[6] Dominique Drouet, *An International Investigation of Urban Infrastructure Management*, (Paris: French Ministry of Urban Development, Housing, and Transport, May 1987).

EXHIBIT VI-1

SUMMARY OF RESEARCH COSTS AND SAVINGS
FOR PROJECTS CARRIED OUT BY THE
CALIFORNIA DEPARTMENT OF TRANSPORTATION, BY REPORTING PERIOD



SOURCE: California Department of Transportation

- Development of new, alternative systems and technologies.
- Management and policy research.

The NRC Committee illustrated these for a selection of public works categories, recognizing that opportunities exist in all categories. The following summarizes the major opportunities for solid waste management.[7]

Improvement of Existing Systems

Solid waste disposal costs are rising. It is time for a careful examination of improvements in known disposal processes to determine their cost-effectiveness. We must examine the possibility of reducing costs through more source separation; we should also study the potential for reducing solid waste by changing product packaging. Research should explore new and more effective techniques to improve the quality of stack emissions. For example, fluidized bed combustion with gas turbines is now being demonstrated with coal; this approach may be efficient and reliable for controlling vaporized metals, dioxin, and sulfur dioxide.

Improved Maintenance of Existing Systems

Although maintenance is not as significant a problem for solid waste management as it is for highways, it deserves attention. Impermeable liners, clay seals, and test wells in landfills will need long-term monitoring and maintenance. Also, we should develop durable and reliable instrumentation for on-line monitoring of incinerator stack emissions, as well as stable sensors to monitor soil and water contamination.

Development of Alternative Systems of Technology

We should study the possibility of using genetically engineered bacteria to accelerate the biological stabilization of garbage. Experience suggests that selling waste-generated power, steam, glass, metals, and paper only marginally reduces municipal disposal costs. However, the rising costs of disposal may make alternative uses of solid waste more attractive.

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[7] Committee on Infrastructure Innovation, National Research Council, "*Infrastructure for the 21st Century: Framework for a Research Agenda*" (Washington, DC: National Academy Press, 1987). The National Research Council is the operating arm of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine which have been chartered by the U.S. Congress to provide the best possible advice on matters of science and technology.

Management and Public Policy Research

Social science and public policy are crucial to effective management of infrastructure. Research into intergovernmental coordination for more efficient solid waste disposal would be helpful. Also important are negotiation techniques for dealing with the problems of siting and using landfills. We must study such things as cost recovery, payment by public works beneficiaries, and compensation for disadvantaged groups.

PROPOSED RESEARCH AND DEVELOPMENT PROGRAM STRUCTURE

A recent study[8] by the Congressional Office of Technology Assessment (OTA) pointed out that effective public works-related R&D in the U.S. has been constrained due to:

- The lack of goals for public works infrastructure.
- The lack of a research agenda directed to national needs.
- A combination of factors (including the highly competitive yet fragmented nature of the industry, the high cost and risks involved in R&D, and the current economic climate) tend to limit the contribution of the private sector.
- Barriers imposed on R&D by government contracting requirements.

The National Research Council (NRC) has examined the potential for breakthroughs in public works R&D and has concluded that the constraints can be overcome with a cooperative, comprehensive, and well-coordinated effort.[9] According to the NRC proposal, the first step in such an effort would be a two-year project to develop a public works R&D program plan. The plan would focus on goals, financing, managerial structure, and constituency involvement.

The NRC believes a comprehensive national agenda is essential to the success of such an effort. This is because of the highly fragmented nature of the public works industry, the large numbers of participants, and the size, diversity, and complexity of infrastructure systems. The NRC proposal calls for Congress to create and fund a two-year effort to accomplish the following:

- Design an organization to formulate a national infrastructure R&D program.
- Determine the appropriate location for existing efforts within the national program.
- Investigate and identify appropriate sources of funding.
- Specify the scope of the organization's responsibility for coordinating, sponsoring, or actually undertaking research projects.

The NRC concluded that a new organization will be able to identify opportunities for improvement which can be found only if infrastructure is perceived as a total system. The NRC emphasized that the organizational structure must accommodate the interests of current constituencies and ongoing R&D efforts.

Federal R&D programs have often underestimated the problems involved in transferring innovations to the field. To avoid this pitfall, the NRC calls for potential adopters, that is, local public works managers and decisionmakers, to be involved early in the planning process. This would ensure that research is focused on high priority areas and should also provide a more practical basis for technology transfer activities.

The National Center for Manufacturing Sciences (NCMS) illustrates what can be accomplished through a cooperative and coordinated public and private effort.[10] A group of U.S. machine tool manufacturers and suppliers are supporting a nonprofit consortium to sponsor a series of manufacturing research, development, and implementation programs. The programs are designed to advance the state of manufacturing sciences, foster the development of manufacturing-process tools and techniques, and disseminate the results to the members of the consortium.

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[8] Office of Technology Assessment, U.S. Congress, "Construction and Materials Research and Development for the Nation's Public Works," June 1987, Staff Paper.

[9] Committee on Infrastructure Innovation, *Infrastructure for the 21st Century*, op. cit.

[10] Lansing Felker, "Cooperative Industrial R&D: Funding the Innovation Gap," in *Bell Atlantic Quarterly* (Winter 1984), Vol. 1, No. 2. Since 1984 sixty-five R&D consortia have been formed and registered with the Justice Department. R&D is usually funded cooperatively to develop base technology which is then used by the member firms individually as the basis for proprietary applications.

The NCMS brings together, in a national R&D partnership, participants who, although they are competitors, recognize the value of R&D. In the face of decreased federal R&D funding and increasing competition from foreign suppliers, they are willing to pool some of their resources to seek shared solutions to technological problems.

Key factors necessary for success, according to NCMS participants, include the following:

- The program must address a common threat or be directed to common goals.
- The R&D agenda must be suitable for cooperative treatment.
- The R&D agenda must be established by the industry participants in response to "market pull," that is, the potential R&D users set program priorities in response to what is needed in the marketplace.
- The R&D agenda should reflect the strategic goals and character of the participating firms to ensure top management's contribution.

Congress recently enacted legislation calling for university transportation research centers in each of the ten federal regions. Each center will be a focus for research, education, and extension activities. Research will cover both immediate and long-range topics. Each center will receive federal funds that must be matched by a combination of state, university, and private funds. The university center approach may also be a useful model for an infrastructure R&D program.

The NRC proposal, the format of the NCMS, and the regional university transportation center concept highlight what a successful national program of infrastructure R&D needs. These include the following:

- A single coordinating institution to provide a focus for the program and to administer and coordinate the work.
- Broad representation from government, industry, academia, and the public-works profession to provide oversight, coordination, and general direction for the program.
- A public-private partnership including all levels of government and coordination with professional groups, manufacturers, associations, and universities.
- A reliable and adequate funding mechanism.

Any infrastructure R&D program must recognize the considerable effort already underway nationwide. R&D concerning public works infrastructure takes place in many federal agencies and facilities, including the U.S. Army Corps of Engineers, the Environmental Protection Agency, and the Department of Transportation. Professional organizations such as the American Public Works Association and the American Water Works Association have established applied research foundations. It is essential that a national R&D effort foster close coordination among these and other relevant programs. It should focus on areas not now adequately covered, and relevant results should quickly enter the public domain.

Finally, funding for the R&D program could come from several sources. Federal funding has long been a major factor in the encouragement of R&D activities. The Highway Trust Fund, which stems from tax on motor fuel, is the primary source of R&D funds for highways. For a major effort in infrastructure R&D, a congressional appropriation could provide initial funding; a percentage of federal public works funds could then be assigned to the program. In addition (or alternatively), a small research surcharge could be assessed to rate payers.

Demonstration Projects

Demonstration projects follow research, development, and pilot testing efforts and precede widespread application. They are designed to put technology into an operating environment.[11] Demonstrations promote new technology by providing incentives for application, by monitoring and evaluating the installation, and by publicizing the results. A formal peer review increases the credibility of a project and the potential for wide acceptance and additional applications for the new technology.

The value of demonstration projects is illustrated by the problems encountered in early research on a revolutionary wastewater treatment concept. The research involved rotating biological contractors (RBC). Small-scale pilot units were inaccurate in predicting performance. Because of this, early full-scale units were undersized. A demonstration of a full-scale operating unit would have provided accurate data before additional units were designed and built.[12]

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[11] American Public Works Association Research Foundation, "Structuring Demonstration Projects of New Technologies," August 3, 1987. Workshop Documents.

Monitoring and evaluation are essential to a demonstration project; proper planning and evaluation protocol are imperative. Once the evaluation is complete, results must be disseminated so that other professionals can benefit from the project.

Risk Sharing

Unproven technology involves considerable risks for the manufacturer or builder, as well as the funding and operating agencies. Demonstrations generally are a response to this risk. Council research has suggested overcoming this barrier to innovation through some formal risk-sharing arrangement; often no single party can afford to accept all the risk. European experience has led to a similar conclusion.[13] This need to spread the risk results from the lack of a credible, authoritative institution in the U.S. to test and approve new technologies and from the nation's litigious character.[14]

A risk-sharing agreement would encourage researchers and developers to consider options beyond the status quo. Such an agreement could also include improvements to cumbersome procurement and regulatory processes (which often discourage innovation). Risk sharing can involve the locality, the design engineers, the manufacturer, the contractor, and other levels of government. Risk analysis techniques are available to assess many new technologies, including commercial aircraft designs, nuclear power plants, exploratory spacecraft, dam safety, power-generating plants, and toxic-waste storage.[15]

Accelerating the Diffusion of Innovation

One way to encourage innovation is to systematically share and spread information and technology. Professional organizations and federal agencies have long had such dissemination and transfer programs. Although these programs transfer information about current practices, information on emerging technologies is not as readily available.[16]

Electronic information systems and desktop computers have made information exchange available at low cost.[17] Managers and staff can access a wide range of data and information. In addition, electronic bulletin boards provide a way to relay local project status reports, to request specific information, and to make general inquiries about problems which may have been examined elsewhere.

Revolutionary changes in both the computer and the telecommunications industries may produce further ways to transfer information. Computer and video conferences could benefit public works professionals. Each has advantages and disadvantages; both can help disseminate information.[18]

Successful information transfer must also use more traditional means such as scientific and technical journals; professional, scientific, and technical society meetings and symposia; intergovernmental meetings; national standards and specifications committees; and technical assistance programs. Information about innovative solutions and how they were developed must be better integrated into the engineering education system, vocational and professional education programs, and technical training programs. This will inform and stimulate student engineers.

KEY RESEARCH AND DEVELOPMENT POLICY ISSUES

There is little doubt that the pace of technological development will continue to provide major advances in fields such as medicine, communications, and biotechnology. Unfortunately, innovation and R&D for infrastructure are currently limited and uncoordinated. The level of R&D expenditures is low and the work being undertaken lacks a national focus. Major benefits could be realized if a national program is organized to fill the gaps and to address high priority public works R&D. Such a program must be a comprehensive and coordinated effort involving government, industry, academia, and public works professionals.

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[12] American Academy of Environmental Engineers, "Environmental Engineering Research Needs: An Issues Paper," August 1987.

[13] U.S. Army Corps of Engineers, Engineer Institute on Water Resources, *Workshop on Risk Analysis Planning* (Washington, DC: June 1987).

[14] Office of Technology Assessment, U.S. Congress, "Construction and Materials Research and Development for the Nation's Public Works," June 1987, Staff Paper.

[15] National Council on Public Works Improvement, "The Potential Role of Risk Analysis in Planning, Design, and Construction of Public Works Facilities," July 1987, Draft Workshop Proceedings.

[16] American Public Works Association, "Good Practices in Public Works," prepared for the National Council on Public Works Improvement, September 1987.

[17] Henry Fersko-Weiss, "On-Line Contacts," *Personal Computing*, January 1987, pp. 83-91.

[18] William G. Wells, "Working Paper on Knowledge Sharing," prepared for The National Council on Public Works Improvement, July 1986, p. 79.

Future infrastructure R&D should continue to provide demonstration projects that apply technological innovation in the field. Demonstration projects with appropriate risk-sharing components are an essential means of promoting innovative solutions and overcoming some of the barriers to their adoption.

Professional organizations and public agencies need to aggressively promote the use of computerized information, along with traditional forms of information transfer.

ENSURING THE AVAILABILITY OF QUALIFIED PERSONNEL

Public works services rely on the managers and staffs who operate and maintain the facilities and equipment. Success depends both on the availability of highly motivated people and on their proper education and training.

A recent study by the Office of Technology Assessment (OTA) suggests that there might soon be a drop in science and engineering college enrollments.[19] Even more disturbing is evidence that the percentage of top level high school graduates enrolling in civil engineering (traditionally the major source of public works engineers) is decreasing.[20] Moreover, civil engineering enrollments are dropping and it appears they will continue to do so.[21] In a survey of accredited civil engineering programs (1983-1984 academic year), 56 percent of the respondents had enrollment decreases, which they deemed "typical of the past few years and likely to be typical of upcoming years."[22]

A majority of senior professionals in public works are engineers and a larger-than-average turnover is expected among these senior professionals through 1990.[23] The combination of fewer trained engineers entering the field and the attrition of senior professionals could pose a serious manpower problem in the near future.

However, OTA also suggests that high school graduates are responsive to market signals, and that actual enrollments often reflect publicized shortages in specific fields. Continuing media coverage has raised public awareness of the need to improve public works. Moreover, groups that have not been traditionally active in science and engineering, (women, blacks, Hispanics, and American Indians), but that enrolled in colleges and universities in increasing numbers from 1974 to 1984,[24] are a prime source for concentrated recruitment into the public works field.[25]

In addition, the public works profession is becoming highly diversified; heavy reliance on engineering and operations has given way to a variety of disciplines. Twenty years ago, the public works professional environment had not yet been touched by the computer revolution, the energy crisis, creative financing, or privatization issues.[26] Today's public works professional must be well-prepared to meet the challenges of these and other emerging topics.

The current working environment has been shaped by many forces; three current trends stand out. First, the desktop computer has made available a host of new tools and techniques that help people work more quickly and effectively. Microprocessor-driven monitoring and data collection devices can be connected to computers for analysis. The immense potential of this resource, along with the improved productivity it can provide, make it imperative that graduating engineers be computer-literate.

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[19] Office of Technology Assessment, U.S. Congress, *Demographic Trends and the Scientific and Engineering Work Force* (Washington, DC, December 1985), Technical Memorandum.

[20] Personal communication with Prof. Harold Michaels, Purdue University, regarding reports under preparation for the American Society of Civil Engineers and the Institute of Transportation Engineers.

[21] Some attribute this to the attraction of new technology in other engineering fields such as industrial engineering (computerized inventory control systems, robotics) and electrical engineering (computers, telecommunications).

[22] Russell Jones, "Crisis in Engineering Education—An Update" in *Challenges to Civil Engineering Educators and Practitioners: Where Should We Be Going?* (American Society of Civil Engineers, 1985).

[23] Transportation Research Board, National Research Council, *Transportation Professionals: Future Needs and Opportunities*, (Washington, DC, 1985). "From 1985 through 1989, about 16 percent of all engineers in state transportation agencies will retire."

[24] National Action Council for Minorities in Engineering, Inc., *Statistical Report. (New York: 1986).*

[25] National Research Council, *Engineering Employment Characteristics. (Washington, DC: National Academy Press, 1985.*

[26] Richard S. Page, in *Transportation Education and Training: Meeting the Challenge* (Washington, DC: Transportation Research Board, 1985), Special Report 210, p. 17.

Another important trend is a focus on maintenance and rehabilitation. We need to make existing equipment cost-effective throughout its life. Engineering curricula provide little, if any, treatment of the problems and solutions of maintenance and rehabilitation.[27] Clearly, engineering schools produce professionals who can develop solutions through application and experience. However, a systematic analysis of maintenance and rehabilitation has not been undertaken, and would be useful in training student engineers.

Finally, we come to the third trend, citizen participation. Citizens have become an important part of community decisionmaking and it is likely that they will remain important, particularly as decisions become more complex and interrelated. Today, public works professionals recognize that communication must be timely and effective to secure public approval during decisionmaking.[28]

Graduate-level public works management programs are offered at several universities. These programs address current trends while pursuing teaching, research, and public service goals. The proposal for a new program at Cleveland State University provides a useful model of the components needed to strike a balance between practitioner and academic participation.[29] The program will include:

- A graduate-level degree program in public works management; the colleges of Engineering and Urban Affairs will collaborate on the degree.
- Seminars, workshops, conferences, and other continuing education programs for public works practitioners.
- Management and technical assistance programs for public works agencies.
- Technical and management research.
- Public information programs on public works issues.

The American Public Works Association has indicated the need for additional financial assistance for this and other existing programs if they are to have any significant impact upon public works professionals.[30]

POLICY IMPLICATIONS REGARDING THE SUPPLY OF QUALIFIED PERSONNEL

In view of the reduction in civil engineering enrollments, just at a time when many senior engineers are reaching retirement age, the United States needs an aggressive effort involving public works practitioners, professional organizations, and the universities to seek out and encourage young people to enter the public works profession. Current engineering curricula are deficient in programs to train young engineers to manage the growing number of maintenance and rehabilitation projects nationwide. Such projects will continue to grow in number and in importance during the coming years; the curricula must include training in these areas.

In addition, engineering and public works administration curricula must include course work on computer systems and communications skills if students are to become successful practitioners into the next century.

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[27] Ronald Meade, "Repair and Renovation of Decaying Curricula," in *Challenges to Civil Engineering Educators and Practitioners: Where Should We Be Going?* (American Society of Civil Engineers, 1985).

[28] Richard J. Grant, "Preparing Engineers to Cooperate with the Public," in *Civil Engineering Education: Responding to the Challenges of Engineering Practice* (New York: American Society of Civil Engineers), Vol. 1, pp. 662-668.

[29] William Dodge, John Hemann, and Michael Spicer, "Public Works Management Education: The Third Response to the Plight of Public Works," Cleveland, August 1987.

[30] Letter to the National Council on Public Works Improvement from Robert Bugher, Executive Director, American Public Works Association, dated January 6, 1988.

FRAGILE FOUNDATIONS: A REPORT ON AMERICA'S PUBLIC WORKS

FINAL REPORT TO THE PRESIDENT AND THE CONGRESS

PART THREE: APPENDICES

National Council on
Public Works Improvement
February 1988

APPENDIX I
EVALUATING THE PERFORMANCE OF EIGHT CATEGORIES OF PUBLIC WORKS

HIGHWAYS, STREETS, ROADS, AND BRIDGES[1]

Historically, the nation's system of roads and bridges have performed well. During the 1960s, while the country was constructing the Interstate Highway System, net capital assets grew continually. Since the completion of the majority of the Interstate System, the accumulation of net capital assets has slowed and even decreased as some roadways reached the end of their useful life. In 1984, however, net capital assets once again began to increase, due to increases in capital spending made possible by the nickel increase in the federal motor-fuel tax as well as extensive state fuel tax increases.

In contrast, vehicle miles of travel have increased steadily at a rate of 3.0 percent annually. Thus, the capital stock of highways, bridges, roads, and streets is being used at an increasing rate.

System cost effectiveness, as measured by the number of vehicle miles travelled per dollar of public spending, has been increasing at 3.5 percent annually since 1960. This suggests that either the nation is making more productive use of its roads and bridges, or that the nation is living on past investment and the public sector is not spending enough to meet growing transportation needs. The indication supported by more detailed analysis is that, to a certain extent, both had occurred through 1984. Increased user taxes supporting greater investment beginning in the 1980s, however, have helped ameliorate the latter problem.

System Overview

The nation's highway system consists of almost 3.9 million miles of roads and bridges with an estimated asset value of $480 billion (in 1984 dollars). Although the federal aid highway system comprises less than one-fifth of the total mileage (843,000 miles), it carries more than four fifths of the total vehicle miles traveled.

The federal aid system has four major components: 43,600 miles of Interstate routes; 257,400 miles of primary highways; 398,200 miles of collector routes in the secondary system; and 144,100 miles in the urban system. The Interstate Highway System itself is 1.1 percent of the entire network, yet carries close to 21 percent of all vehicle miles of travel (Exhibit A-1).

EXHIBIT A-1
HIGHWAY MILEAGE BY FINANCE CATEGORY

Highways by Finance Category	Route Miles	% of Total System	% of Total Vehicle Miles
Federal-Aid Highway System			
Interstate	43,593	1.1	20.9
Primary	257,413	6.7	29.2
Secondary	398,248	10.3	8.8
Urban	144,055	3.7	21.6
Bridges (Number)	(271,300)	N/A	N/A
Total Federal Aid	843,309	21.8	80.5
Off Federal-Aid Highway System			
Roads	3,018,625	78.2	19.5
Bridges (Number)	(304,307)	N/A	N/A
Total	3,861,934	100.0	100.0

Source: Based on data in Federal Highway Administration, *Highway Statistics for 1985* and the *Highway Bridge Replacement and Rehabilitation Program (1987)*.

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[1] For a more detailed discussion, see Apogee Research, Inc., *A Consolidated Performance Report on the Nation's Public Works*, 1987, pp. i-iv and 39-74, and Alan E. Pisarski, *The Nation's Public Works: Report on Highways, Streets, Roads and Bridges*, National Council on Public Works Improvement, May 1987.

The vast majority of all roads and streets in the United States are under the jurisdiction of state and local governments. Only 226,157 miles (5.9 percent of all route-miles) are under direct federal jurisdiction. These are mostly roads in national forests and parks, and roads on military and indian reservations.

The U.S. network of roads and bridges is a system designed to provide road access to all parts of the country. Thus, while less travelled, the remaining 3,019,000 miles of predominately local and rural roads off the federal aid system provide important access to and from the federal aid system. As such, they provide significant economic value primarily for local residents and businesses.

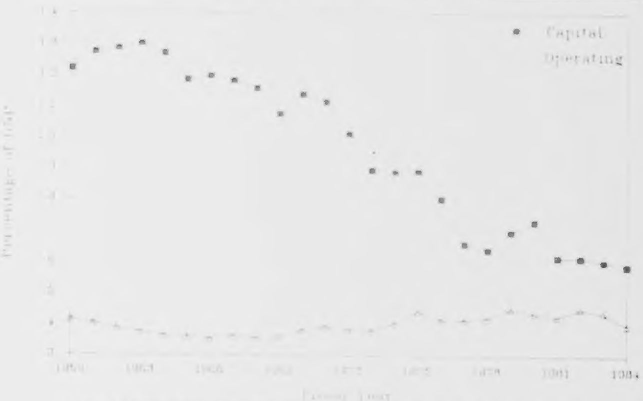
The private sector has close to a trillion dollars invested in motor vehicles of all kinds—more than twice the public sector investment in roads and bridges. Further, considerable personal and work resources are dedicated to the movement of people and goods. In fact, for every dollar the public sector spends to construct, operate and maintain the roadway network, the private sector spends $15 to move people and goods. Therefore, it is important that public investment in road infrastructure provide the capacity to make full use of this large investment in private assets.

In 1985, real federal, state, and local spending on the nation's highways, streets, roads and bridges was $45.1 billion. This represents an increase in total spending of 24 percent since 1960, but is still 9 percent below the peak reached in 1971. Capital spending by all levels of government was $23.9 billion in 1984, or about 0.6 percent of GNP. As Exhibit A-2 indicates, this reflects a steady decline in the relative importance of capital spending on highways, streets, roads and bridges since the early 1960s. In part, this decline in the relative importance of capital spending reflects the near completion of the federal Interstate System.

PHYSICAL ASSETS

Four measures were chosen to represent current physical assets in the highway system: route-miles; net public investment; number of bridges; and the number of vehicles. Each measures a different aspect of the system. Total route-miles measures the extent of the system; net asset value shows the accumulated value of the stream of past public spending; the number of bridges measures the assets in the bridge program; and the number of registered vehicles is one measure of the private involvement in the highway system.

EXHIBIT A-2
TOTAL PUBLIC EXPENDITURES FOR HIGHWAYS
STREETS, ROADS AND BRIDGES



SOURCE: Apogee Research, Inc. from U.S. Department of Transportation, Federal Highway Administration

Route-miles

The most rudimentary measure of the physical assets of highways is the number of miles in the system. Total miles grew from roughly 3.55 million in 1960 to a peak of 3.92 million miles in 1979. This total has since fallen slightly to 3.86 million miles in 1985. The reason for this drop is not immediately obvious. Some of the difference may be that many low-volume, non-surfaced roads are taken over by the private sector, while other segments have been closed entirely.

Total lane-miles offer a similar, yet more comprehensive, measure of physical assets. A mile of four-lane highway can handle more traffic at a higher level of service than can a mile of road with two lanes—a difference which route-miles alone do not capture. For example, the 43,593 route-miles of Interstate highways represent 189,135 lane miles.

Since comprehensive lane-mile data only exist since 1982, long-term trends in the growth of lane-miles are not readily available. However, because of the rapid growth in expressways in recent decades, the percentage of the highway system according to lane-miles is slightly more than when measured by route-miles. For example, the share of the Interstate System increases from 1.1 to 2.4 percent of the total system measured in lane-miles.

Net Asset Value

Net asset value (a measure of capital stock) and net investment (a measure of financial flow) in highways, streets, roads and bridges gauges the value of physical assets in this mode. Net investment shows the estimated dollar value of total public investment in highways in any one year. Net investment in highways climbed rapidly at an annual rate of increase of 3.9 percent during the 1960s, fell to about zero from 1977 to 1979, and fell off slightly at a rate of minus 0.5 percent in the early 1980s.

As a result of this pattern in net investment, the accumulated asset value of the nation's highways, streets, roads and bridges increased from $250 billion in 1960 to about $480 billion in the late 1970s. In the early 1980s, however, the value of the capital stock declined slightly (Exhibit A-3).[2]

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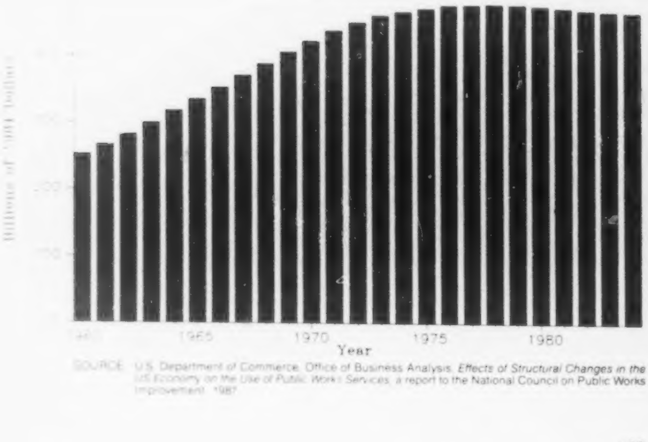
[2] U.S. Department of Commerce, Office of Business Analysis, in *Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services*, a report to the National Council on Public Works Improvement, (1987). The Department of Commerce used an average life of 28 years for highway investments. Because of data limitations, total highway assets are slightly (0.2 percent) underestimated for 1960-1965.

EXHIBIT A-3
NET ASSET VALUE OF HIGHWAYS, STREETS, ROADS AND BRIDGES



SOURCE: U.S. Department of Commerce, Office of Business Analysis, *Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services*, a report to the National Council on Public Works Improvement, 1987.

The most probable reason for the decline in net capital stock over the early 1980s has to do with declining public capital spending on highways, streets, roads and bridges. Total annual public capital spending peaked in 1968, falling off dramatically through 1982. At the same time, existing capital was wearing out. A great many of the existing roads and bridges were put into place during the 1950s and 1960s. These data assume an average estimated life of roads and bridges of about 28 years, thus much of this investment would have reached the end of its useful life during the early 1980s.

However, the downward trend in net capital assets probably bottomed out in 1984, and is likely to turn upward in the following years. In 1982, the federal motor fuel tax was increased by five cents per gallon. Many states have raised their motor fuel taxes in recent years as well. Consequently, total capital spending began to increase in 1983.

Bridges

As of 1985, the total number of bridges was 575,607. Of these, 271,300 are part of the federal-aid system including: over 51,300 Interstate System bridges; 92,000 bridges in the Primary System; 91,000 bridges in the Secondary System; and 37,000 Urban System bridges. The remaining 304,307 bridges are off the federal-aid system. The number of bridges in the bridge inventory both on and off the federal-aid system has been growing since 1975. This is due partly to more comprehensive reporting, but also to increased bridge construction as part of efforts to improve highway alignments.

Number of Vehicles

The private sector currently has close to a trillion dollars invested in motor vehicles of all types.[3] The measure of motor vehicles in the system is the number of vehicles registered in any given year. Total motor vehicle registrations have climbed steadily at a rate of 3.7 percent annually, from 70 million in 1960, to 172 million in 1985. These vehicles are predominantly automobiles, which have accounted for 75 percent of the increase in motor vehicle registrations since 1942. However, in recent years, the number of registered buses and trucks has been growing at an increasing rate. This finding is reflected in vehicle miles of travel by trucks as well as increasing ton-miles of travel.

Service Delivery

The most important economic service that the highway system provides is the movement of people and goods. Three different factors were chosen to measure this output: vehicle miles, passenger miles, and ton-miles.

Vehicle Miles of Travel

Vehicle miles of travel (VMT) is the most comprehensive measure of highway output as it captures both passenger and freight highway use. VMT has grown steadily at a compound rate of roughly 3.7 percent per year, from 719 billion miles in 1960, to close to 1.77 trillion in 1985. In fact, since World War II, highway use as measured by VMT has declined only twice—in 1974 and in 1979—both during severe petroleum shortages.

VMT is made up predominantly of passenger vehicle travel, although the truck share has been increasing slowly since 1965. The amount of VMT each household devotes to specific trip purposes has also changed. The VMT categorized as home-to-work travel fell 15 percent between 1969 and 1983. In contrast, VMT logged for shopping purposes rose 69 percent and vehicle miles traveled for other family and personal business rose 43 percent during that same period.[4]

While useful as a measure of the physical output of highways, VMT masks an important shift in highway use. Passenger-miles are growing at a faster rate than passenger VMT. This implies a shift toward higher vehicle occupancy. Consequently, the measure of VMT alone underestimates the increased use of the system.

Second, the amount of truck travel was not greatly affected by either oil crisis. In fact, truck VMT continued to grow through both oil shortages. This reflects the fact that petroleum is not a large portion of total trucking costs, and most of the added cost can be passed on to the consumer. Demand for truck transport is most sensitive to economic activity.

Passenger Miles

Highway passenger miles have nearly doubled since 1965, increasing from 1.5

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[3] Motor Vehicle Manufacturer's Association, "Economic Indicators—The Motor Vehicle's Role in the U.S. Economy," 3rd Quarter 1986.

[4] U.S. Department of Transportation, *Nationwide Transportation Study*, "Summary of Travel Trends", 1983-1984.

trillion in 1965 to 2.9 trillion in 1984—a compound annual increase of more than 3.5 percent. As with VMT, passenger-miles of travel was also affected by the petroleum shortages. Indeed, the impact on passenger miles was greater since passenger travel is more price elastic than total VMT. This indicates that the greatest decrease was in discretionary travel, such as vacation or family trips, while the number of passenger miles devoted to work and business remained approximately the same.

Ton-Miles

In 1965, 359 billion ton-miles of freight moved on the nation's highways. By 1984, this figure reached 610 billion ton-miles, a compound annual increase of 2.7 percent (Exhibit A-4). In 1965, trucks accounted for nearly 22 percent of all freight transport. By 1985, trucks moved 40 percent of the total tonnage, and accounted for three-quarters of the nation's freight bill.

QUALITY OF SERVICE

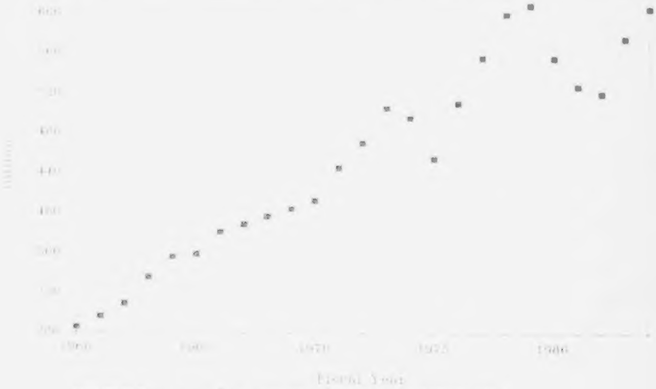
Three measures of the quality of service provided by the highway system are presented: pavement conditions of the roadways, including the percent of roadway mileage that is paved; fatality rates by functional class of road; and changes in the cost to use the system as measured by the Federal Highway Administration (FHWA). As shown by these measures, the quality of service has generally been improving in recent years, in some cases reversing trends of the 1970s.

Pavement Conditions

The condition of the pavement on the nation's roads and bridges, as well as the type of surfacing itself, is an important measure of the quality of service provided by the highway system. Pavement conditions affect speed of travel, vehicle operating costs, smoothness of the ride, safety, etc. During the 1970s, overall pavement conditions for the federal-aid system declined.

In 1975, FHWA rated roughly 19 percent of urban and rural Interstate pavement as deteriorated or deteriorating. The portion of Interstate pavement in deteriorated or deteriorating condition steadily increased through 1983, to a high of 29 percent. From 1983 to 1985, this trend was reversed, and the portion of total Interstate mileage in such condition fell 3.2 percentage points, from 28.9 percent in 1983, to 25.7 percent in 1985. This improvement reflects the increase in federal and state funds for resurfacing

EXHIBIT A-4
INTERCITY TON—MILES OF FREIGHT



SOURCE: Transportation Policy Associates, "Transportation in America" (5/87) following passage of the nickel tax increase in 1982.

The pavement conditions on other arterials are worse than on the Interstate System. That is, a higher percentage of mileage (over 40 percent since 1975) falls into the category of deteriorating or deteriorated pavement. Further, the standards applied are more stringent for the Interstate System. That is, the Pavement Serviceability Index (PSI) rating on Interstate pavement need only fall below 2.5 to be considered in deteriorating condition, whereas the PSI on other arterials must fall below 2.0. Relative to the Interstate, worse physical conditions may be expected for these systems simply because they are used less intensively.

Fatality Rates

The number of roadway fatalities has been declining over recent years. From 1965 through 1973, fatalities rose from 50,000 to roughly 55,000 motor vehicle accident fatalities annually. After 1973, the number of fatalities dropped off dramatically, partly due the new 55 mile-per-hour speed limit law. Although there was a slight upward trend from 1975 to 1980, the number of annual road-related fatalities is generally declining once again.

In addition, the fatality rate over all systems declined 55 percent between 1965 to 1985, from roughly 5.5 fatalities per 100 million VMT, to close to 2.5 fatalities per 100 million VMT.

Despite its higher average speed, the Interstate System has a lower fatality rate than the system as a whole. This is the result of the higher design standards applied to the Interstate and from the uniform speeds at which vehicles travel. As with the system as a whole, the fatality rate has generally decreased, showing its biggest decline right after the 55 mile an hour speed limit was instituted. In 1985 there were 1.1 fatalities per 100 million VMT on the Interstate System, a decrease of 18 percent from 1976, and a decrease of 51 percent from 1973.

Private Costs

Changes in pavement and bridge conditions, congestion levels, and highway geometries affect the cost to use the nation's roads and streets. These highway user costs are a dollar estimate of the quality of the services provided by the network and a measure of composite highway performance. FHWA estimates of the unit costs for highway use are based on the economic costs to society of increased travel times, accidental injuries and death, and vehicle operating costs.

There are two limitations to using these data. First, changes outside the highway system can account for most short-term changes—shifts in fuel prices being the most obvious factor. Second, these estimates reflect subjective judgments of how to gauge certain costs. For example, there are serious technical problems in estimating the value of time, apart from tackling the sensitive issue of assigning dollar values to injuries and loss of life. However, from the perspective of the economic benefit to society, these numbers make useful comparisons.

From 1980 to 1983, average vehicle mile costs to use the system increased roughly 1.3 percent. The biggest increases occurred in the Interstate System, which jumped 5 percent, and on other expressways and principal arterials, which increased about 2 percent. This trend reversed, however, from 1983 to 1985. The overall unit cost to travel fell, with the biggest decrease in operating costs. Both accident costs and time costs dropped as well. In fact, unit costs fell in all but four of the 30 categories used for this analysis.

Investment Efficiency

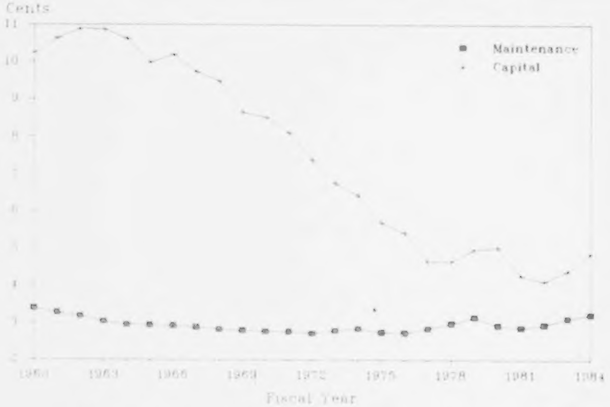
This analysis focuses on several measures of cost-effectiveness. Featured are spending relative to assets and capital and maintenance expenditures relative to VMT.

Spending Relative to Assets

The change in the ratio of public capital spending per dollar of assets approximates the rate at which the capital stock is being replaced and expanded. Capital spending rose to a high of 11 cents per dollar of assets in 1963. If no funds were used to add capacity, this rate of spending implies a replacement cycle of approximately nine years. Roughly one-half of the 11 cents per asset dollar represents new expansion to the system, however (Exhibit A-5).

After virtual completion of the Interstate, capital spending per asset dollar declined to a low of 4 cents in 1982, or an implied replacement cycle of 25 years. This spending level per asset dollar has not been enough to cover depreciation, and has resulted in a decrease in net stocks. After 1982, capital spending per asset dollar began to rise again, so that net assets began to increase in 1985 and 1986. This is due to the federal nickel tax

EXHIBIT A-5
CAPITAL AND MAINTENANCE SPENDING



SOURCE: Apogee Research, Inc. from U.S. Department of Commerce, Office of Business Analysis and U.S. Department of Transportation, Federal Highway Administration data.

increase and state motor fuel tax increases.

Public operation and maintenance expenditures per dollar of asset value is an additional measure of the adequacy of public spending on the highway system. In 1960, public maintenance spending per dollar of asset value was roughly 3.5 cents. This dropped to a low of 2.8 cents per asset dollar in 1976. Maintenance spending per asset dollar subsequently increased to roughly 3.5 cents in 1984.

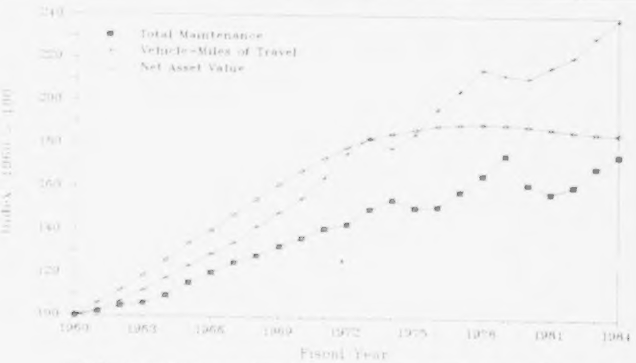
An indexed comparison reveals some important system trends (Exhibit A-6). During the 1960s, for example, net asset value was growing at a faster rate than both VMT and maintenance spending. This suggests there was increasing excess capacity in the system during that period. However, from 1977-1984, net asset value peaked and began to decline while VMT and maintenance spending continued to grow. As a result of this imbalance, any excess capacity will eventually be absorbed by the continued growth in VMT, so that the 1980s may contain a period of living off of past investments.

Capital and Maintenance Spending Relative to VMT

Public capital and maintenance spending relative to highway use is one important measure of adequate investment in and maintenance of our nation's system of roads and bridges. Neither capital nor maintenance spending have kept pace with growing highway use, although maintenance spending has not fallen far behind increases in VMT. Total public capital expenditures per VMT rose from 1950 to the mid 1960s, peaking at roughly $39 (measured in 1984 dollars) per 1000 VMT. It then declined steadily from 1966 through the early 1980s (Exhibit A-7). These trends reflect the drop in total capital spending between 1968 and 1982 while VMT continued to grow at an average of 3.7 percent per year (Exhibit A-8). Capital spending per 1000 VMT has averaged about $12.50, or about 1.2 cents per vehicle mile, since 1980.

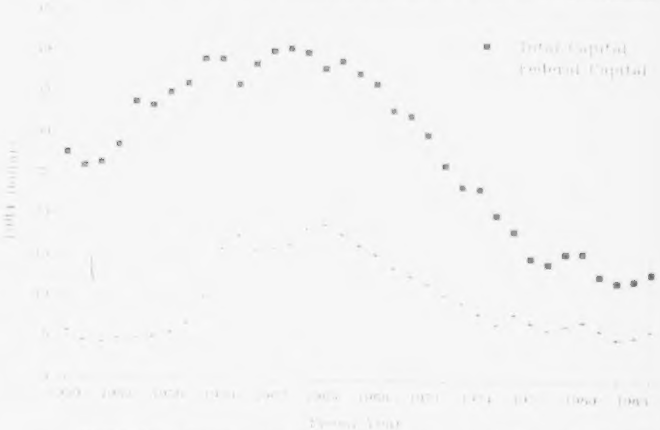
Total maintenance spending per VMT declined steadily from slightly more than $13 per 1000 VMT in 1950, to less than $9 per 1000 VMT in 1984 (Exhibit A-9).

EXHIBIT A-6
NET ASSET VALUE, VEHICLE-MILES OF TRAVEL AND PUBLIC MAINTENANCE SPENDING ON HIGHWAYS STREETS, ROADS AND BRIDGES



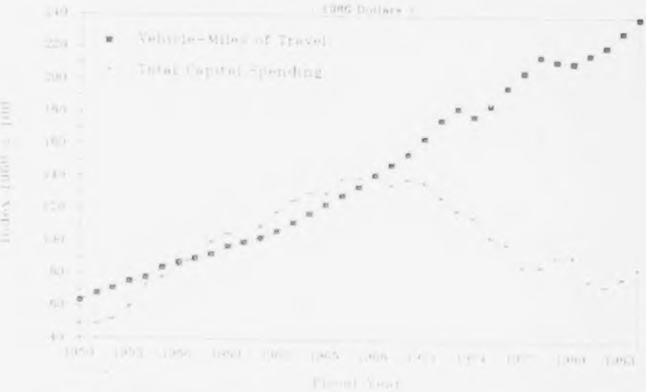
SOURCE: Apogee Research, Inc., from U.S. Department of Commerce Office of Business Analysis and U.S. Department of Transportation, Federal Highway Administration data.

EXHIBIT A-7
CAPITAL SPENDING PER 1,000 VEHICLE MILES OF TRAVEL



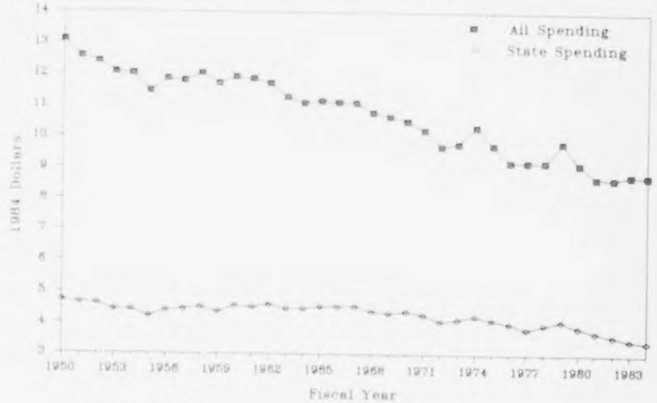
SOURCE: Apogee Research, Inc., from U.S. Department of Transportation, Federal Highway Administration data.

EXHIBIT A-8
COMPARISON OF VEHICLE-MILES OF TRAVEL AND TOTAL CAPITAL SPENDING FOR HIGHWAYS, STREETS, ROADS AND BRIDGES



SOURCE: Apogee Research, Inc., from U.S. Department of Transportation, Federal Highway Administration data

EXHIBIT A-9
MAINTENANCE SPENDING FOR HIGHWAYS, STREETS, ROADS AND BRIDGES PER 1,000 VEHICLE-MILES OF TRAVEL



SOURCE: Apogee Research, Inc., from U.S. Department of Transportation, Federal Highway Administration data

This does not reflect an absolute decline in maintenance spending (total maintenance spending increases fairly steadily over this period), but rather a higher rate of growth in vehicle-miles traveled. This point is made even clearer when maintenance spending is indexed against VMT (Exhibit A-10). While maintenance kept pace with VMT through 1962, the growth rates have since diverged, with VMT growing much more rapidly.

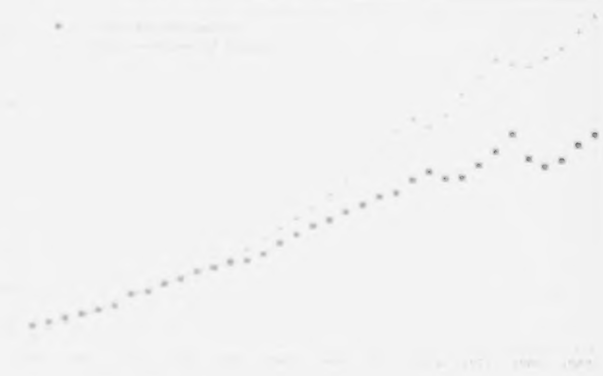
By 1985, the nation's private capital spending equalled roughly $92 dollars per 1000 VMT, or about 9 cents per mile. Maintenance spending was even higher, equalling close to $137 per 1000 VMT, or close to 14 cents per mile.

Private sector spending has been more cyclical. For example, the 1979 oil crisis caused a large jump in private O&M spending from $132 per 1000 VMT to almost $162 per 1000 VMT, which provided an incentive to buy new cars and caused capital spending to increase again in 1983 (Exhibit A-11).

Freight expenditures per ton-mile show a general downward trend, falling from $382 per 1000 ton-mile in 1974 to $326 in 1985. The only dramatic increase in freight expenditures occurred in 1979, again corresponding to the huge jumps in oil prices. Nevertheless, the overall downward trend implies that the trucking industry is becoming more efficient at moving larger amounts of freight. However, this may be due to larger trucks, rather than more efficient public road systems.

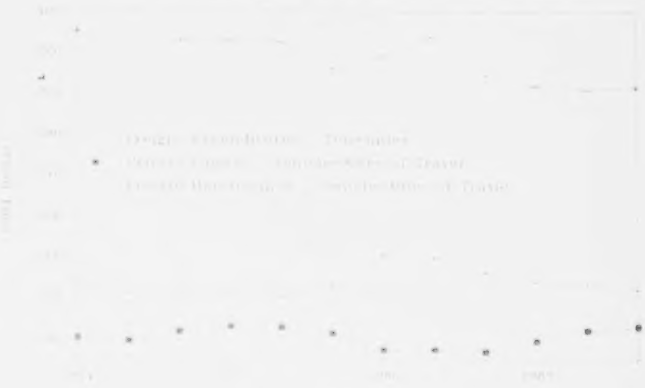
EXHIBIT A-10

COMPARISON OF VEHICLE-MILES OF TRAVEL TO MAINTENANCE SPENDING FOR HIGHWAYS, STREETS, AND ROADS AND BRIDGES



SOURCE: [illegible] Department of Transportation, Federal Highway Administration

EXHIBIT A-11
PRIVATE-SECTOR SPENDING PER 1,000 VEHICLE-MILES OF TRAVEL



[illegible] Federal Highway Administration

MASS TRANSIT[5]

The primary objectives of mass transit systems are to provide mobility in congested areas and transportion for individuals with limited access to automobiles. Transit also provides benefits to nonusers. These include reductions in congestion and automobile travel time, reductions in air and noise pollution, and preservation of land for certain uses which the public prefers.

By most measures, transit systems have not performed well. Despite a large infusion of federal funds, trips per bus-mile fell at an annual rate of 0.8 percent between 1970 and 1983. Labor productivity declined from nearly 14,000 vehicle miles per employee in 1965 to under 11,000 in 1983. Costs per passenger, after adjusting for inflation, have more than doubled since 1970.[6] In addition, there is evidence that transit is over-capitalized in many places. (Important exceptions occur where large rehabilitation requirements exist, such as in New York, and other densely populated, older cities.) This over-capitalization is reflected in the relative growth in the number of vehicles in the system, compared to the growth in ridership. The number of transit vehicles grew at an annual rate of 2 percent over the period 1970 to 1985, while ridership over the same period increased at half that rate.

Much of the decline in performance is largely due to forces beyond the control of transit managers. The most important factors have been the increased suburbanization of jobs and residences and greater use of automobiles due to increased real income.

Physical Assets

More than 5,000 mass transit organizations provide some 2 billion vehicle miles of mass transit service per year. The vast majority of these transit providers, however, operate very small systems or serve specialized populations.[7] The American Public Transit Association (APTA) estimates there are 805 transit systems in urbanized areas and 925 in small urban and rural areas.

In total, mass transit systems operate more than 107,000 vehicles, 60,827 of which are transit buses (Exhibit A-12). To support this fleet, the transit infrastructure includes 1,583 route miles of rail rapid transit track, 419 miles of street car track, and 4,886 miles of commuter rail track. In addition, large portions of the nation's urban highways provide rights of way for buses, van pools, car pools, and other special transit vehicles.

EXHIBIT A-12

COMPOSITION OF MASS TRANSIT FLEET, 1984

Vehicle Type	Number
Buses	60,827
Subway Cars	10,084
Streetcars and Cablecars	948
Commuter Rail Cars	4,111
Commuter Rail Locomotives	329
Vans	2,483
Other	56
Rural Services Vehicles (primarily vans)	12,142
Elderly and Handicapped Service (primarily vans)	16,796
TOTAL	107,776

SOURCE: Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation Performance and Conditions* (June 1987).

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[5] This section is drawn from Apogee Research, Inc., *A Consolidated Performance Report on the Nation's Public Works*, and R. F. Kirby and A. T. Reno, *The Nation's Public Works: Report on Mass Transit*, both prepared for the National Council on Public Works Improvement.

[6] American Public Transit Association, "Transit Fact Book," various years.

[7] For a discussion of the general problems faced by operators of small and low-density public works facilities and the potential policy options available to solve these problems, see Apogee Research, "Problems in Financing and Managing Smaller Public Works Facilities," (August 1987), prepared for the National Council on Public Works Improvement.

In urbanized areas, public transit accounts for 97 percent of all transit vehicles, 89 percent of vehicle miles operated, and 90 percent of all passenger trips.

Two trends in particular demonstrate how changes in demographics and public policy have manifested themselves in transit physical assets: The number of transit passenger vehicles and the net depreciated value of the existing asset base.

Total Passenger Vehicles

The total mass transit fleet declined from 86,310 in 1950 to 61,298 in 1970, paralleling drops in ridership. The number of vehicles began rising in 1975, stimulated by federal capital funding and reached 73,700 by 1983.[8] The number of heavy rail cars has shown little change from 1950 through 1985, dropping from 9,800 in 1950, to 9,000 in 1960, and then slowly increasing to 10,116 in 1985.

Despite the large decline in the number of transit passengers, there has been relatively little change in the number of transit buses since 1950. After dropping to about 50,000 in the 1960s and early 1970s, the size of the fleet recently climbed to about 60,000. The Urban Mass Transportation Administration (UMTA) estimates that the current bus fleet may be 20 to 30 percent larger than needed for peak-hour travel.[9]

Street cars (light rail) and trolley coaches represent the only major vehicle class to show a significant decline. Both dropped dramatically in number between 1960 and 1975—a drop from 19,732 vehicles in 1960 to 1,628 in 1975. Since 1975, there has been little change in the number of these vehicles.

The number of new passenger vehicles delivered averaged about 4,200 a year in the early 1980s, slightly down from the 4,400 of the late-1970s, but substantially more than the roughly 3,000 a year average from 1950 through 1975 (Exhibit A-13). Buses compose 80 to 90 percent of new vehicles, reflecting their greater proportion of the total vehicle fleet and shorter life expectancy. Rehabilitation seems to be playing an increasing role, with about 4,000 buses being rehabilitated a year.

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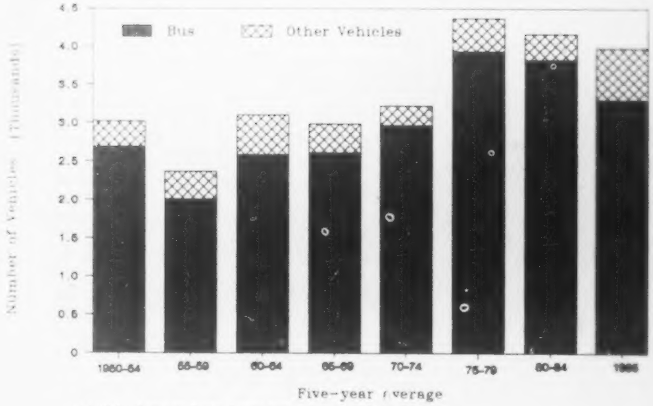
[8] The total vehicle fleet is much larger—107,000 according to UMTA and 95,000 according to APTA—but these totals include commuter rail cars and special-purpose vans and thus are not comparable with APTA's tabulation of historical data.

[9] Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions*, (June 1987).

EXHIBIT A-13
NEW MASS TRANSIT PASSENGER VEHICLES DELIVERED



SOURCE: American Public Transit Association, 1987 Factbook.

Net Asset Value

The trend in the net value of fixed mass transit assets reflects recent growth in capital spending. Since 1965, transit's fixed assets have grown from about $10 billion (1984 dollars) to $34 billion in 1984. This growth has greatly outstripped trends in passenger trips (Exhibit A-14).

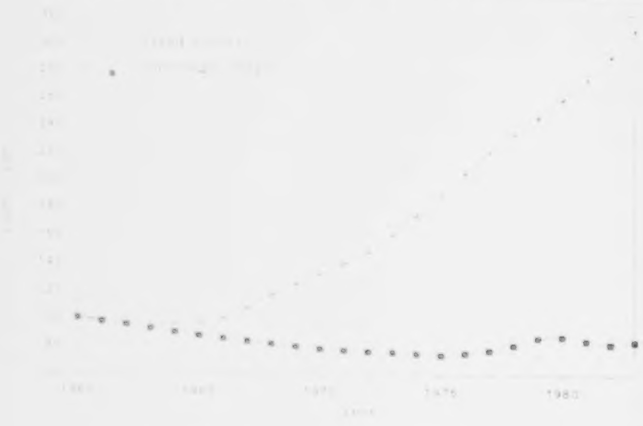
Much of this growth in assets reflects an attempt to correct the deteriorating condition of the nation's rail systems and bus garages that occurred in the decades following World War II. Thus, a large portion of the rapid growth in assets reflects the replacement of a greatly depreciated capital stock.

A significant portion of the remainder of asset growth represents the addition of new capacity in the form of new rail transit systems, such as those in Atlanta, San Francisco, and Washington, D.C.

Service Delivery

Despite large infusions of government funding, public transportation's share of urban travel declined from 3.6 percent to 2.6 percent from 1969 to 1983. Transit's share of commuter trips dropped from 12.5 in 1960, to 6.2 percent in 1980 (Exhibit A-15).

EXHIBIT A-14
TRENDS IN URBAN TRANSIT FIXED ASSETS AND PASSENGER TRIPS



Source: Applied Research, Inc. from U.S. Department of Commerce data.

EXHIBIT A-15
TRENDS IN MODAL SHARE OF WORK TRIPS (in percent)

	1960	1970	1980
Public Vehicles	69.5	80.6	85.9
Public Transit	12.5	8.5	6.2
Walk to Work	10.4	7.4	5.6
Work at Home	7.4	3.5	2.3
TOTAL	100.0	100.0	100.0

Source: Bureau of the Census, Current Population Reports, various years.

Socio-economic trends continue to work against transit and significant change in how transit service is provided may be needed. For example, growth in intersuburban travel has increased public reliance on automobile travel, as has the recent decline in the price of energy.

Major demographic shifts have also contributed to the decline in public transit use. Jobs, particularly in suburban areas, have grown faster than the population as a whole, precipitating increasing emphasis on suburb-to-suburb travel that may ultimately mean greater reliance on car pools and van pools. The growth of automobile ownership has paralleled these new jobs, which permits a reduction in the use of mass transit facilities.[10]

Thus, transit has been meeting less and less of the mobility requirements of the general population, although specialized services for the elderly and handicapped have increased. While transit provides less than 7 percent of the trips by low income urban residents, for example (household income of less than $10,000 in 1983), fully 28 percent of all transit trips are by lower income people.[11]

While the demographics of transit users are important, so too is the distribution of trips. In cities over 2 million, 60 percent of transit trips are by bus, with most of the rest by subway or other form of rail transit. Overall, buses provide two-thirds of the nation's transit trips, including virtually all transit service in urbanized areas under 2 million. Some 89 percent of transit trips are in urbanized areas larger than one million.

Passenger miles and vehicle miles provide the detail underlying these trends in service delivery.

Passenger Miles

Perhaps the most widely used measure of transit output is passenger miles per year. This measure gives greater weight to longer trips such as those by commuter rail. Passenger trips are a more problematic measure of output because they have been reported in various sources and at various times as unlinked (boardings) or linked (transfers subtracted out).

Transit passenger miles increased from 1977 to 1980, and then declined through 1983. This growth follows several decades of decline. Changes in data reporting from 1983 to 1984 make it uncertain whether the number of passenger miles began ascending again in 1984. All the dominant modes of transit have exhibited roughly constant levels of passenger miles of output, with minor fluctuations.

Vehicle Miles

Another measure of transit industry output is annual vehicle miles. The total number of vehicle miles in 1985 was 2.5 billion, less than the 3 billion in 1950. The overall decline in vehicle miles of service has not been as sharp as the drop in transit use. In 1950, there was an average of 5.7 transit trips per vehicle mile operated, versus 3.6 in 1985—a 37 percent drop in the intensity of use. Most of this drop has occurred in buses, with the average number of trips per heavy and light rail vehicle showing very little change. This difference may reflect the use of rail systems in cities that depend more on mass transit. The number of vehicle miles of trolley coach and light rail operations has dropped substantially; it has dropped only slightly for motor bus and risen fractionally for heavy rail.

The U.S. DOT uses vehicle revenue hours to measure output in addition to passenger miles. They define a unit of transit service produced as a vehicle (bus, rail car, street car, etc.) operated in revenue service for one hour or one mile. Since labor costs compose more than 70 percent of the total cost of transportation service, the DOT argues, it is preferable to use vehicle revenue hours as the unit of transit service output for purposes of measuring efficiency and the productivity of labor. Buses account for 76.9 percent of total revenue vehicle hours for 1984, while rapid rail accounted for 15.9 percent.

Other measures of service—route miles per square mile and vehicle revenues per route mile—have remained roughly constant since 1980.

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[10] Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation, Performance and Conditions* (June 1987), p. 44.

[11] U.S. Department of Transportation, *Nationwide Personal Transportation Study, 1983-4* (1986).

Quality of Service

Quality of service is a function of safety, convenience, and maintenance. UMTA data suggest that fixed route transit's safety record improved between 1980 and 1984, with the exception of trolleys.[12]

One way to measure convenience and maintenance is to look at vehicle hours per mechanical roadcall by mode. This is an indicator of breakdowns (Exhibit A-16). After recent declines, all modes showed an improvement from 1981 to 1984. The average yearly increases for each type of transit during the period are as follows:

Bus	10.5 percent
Rapid rail	5.9 percent
Streetcar	41.3 percent
Trolley bus	49.9 percent
Demand Response	3.7 percent

For example, bus breakdowns occur about once every 200 hours, or about once every 3,000 miles. The frequency of these breakdowns varies considerably from city to city, with higher rates where local roads are worse or streets are more congested such as New York City.

There is a close link among transit operating costs, level of service, and the physical condition of local streets and highways. For example, heavy traffic slows buses, adding to labor costs and discouraging bus riders. Although local street conditions deteriorated during the 1970s, there are signs of improvement and conditions are adequate for most mass transit purposes.

The physical condition of rail transit facilities recently was evaluated based on a series of on-site inspections of 34 systems.[13] Conditions were rated on a five-point scale, from bad to excellent (Exhibit A-17). Generally, maintenance facilities and rail yards are in the poorest condition, with 58 percent rated as bad or poor. Self-propelled cars—rapid transit, light rail, and commuter cars—also appear to have significant condition deficiencies. In contrast, more than half the unpowered rail cars were rated in good or excellent condition. Only a small percentage of structures (including tunnels) were rated as poor or bad. However, most were classed as fair, indicating a future need for significant expenditures to replace or reconstruct those essential facilities.

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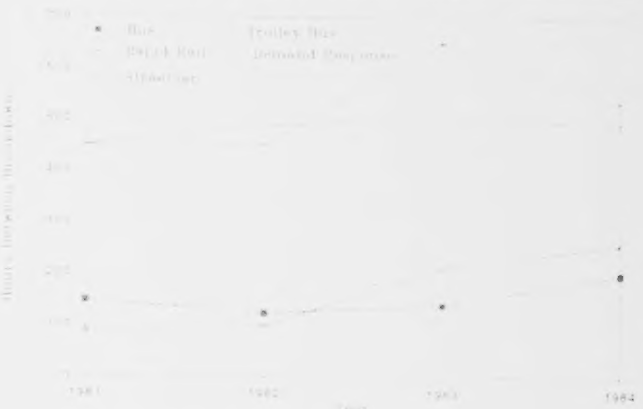
[12] Urban Mass Transportation Administration, Compendium of Transit Data for 1984, pp. 149 and 153.

[13] Gannett Fleming Transportation Engineers, Inc. et al., "Rail Modernization Study," prepared for Urban Mass Transportation Administration, Office of Grants Management, April 1987.

EXHIBIT A-16
VEHICLE HOURS BETWEEN BREAKDOWNS



SOURCE: U.S. Department of Transportation Compendium for 1984, p. 147

EXHIBIT A-17.
RAIL SYSTEM CURRENT CONDITIONS BY ENGINEERING SUBELEMENT
(percent of element in each condition)

Element	CONDITION				
	Bad	Poor	Fair	Good	Excellent
Track	0	7	49	31	12
Vehicles					
Self-Propelled Rail Cars	23	24	18	28	7
Locomotive	3	13	35	49	0
Unpowered Cars	3	10	32	43	12
Power Systems					
Substations	6	23	5	43	23
Overhead	20	12	27	36	
Third Rail	13	26	19	36	6
Stations	0	15	56	23	6
Structures					
Bridges	1	16	51	28	4
Elevated	0	1	80	3	16
Tunnels	0	5	49	35	11
Maintenance					
Facilities	4	54	14	24	4
Yards	4	53	26	16	1

SOURCE: Gannett Fleming Transportation Engineers, Inc., et al., *Rail Modernization Study*, p. 2 (1987).

Investment Efficiency

Mass transit productivity levels have dropped across a wide variety of measures. Although assets have continued to increase, ridership and labor productivity have declined. Between 1970 and 1984, costs per passenger more than doubled. In 1984, total cost per passenger was estimated to be $1.64, total revenue per passenger was $1.18, and total capital assistance was $0.46.[14]

Operating and maintenance expenses per passenger mile increased in recent years. These increases reflect the higher labor content of transit services and the relatively faster increase in labor costs in recent years.

The amount of energy consumed per revenue passenger mile has declined over the last decade, indicating that transit is making more productive use of energy. However, the differential in energy consumed per passenger mile between single-occupancy autos and mass transit has also declined, which reduces the savings gained by attracting travelers away from single occupancy autos.

Passenger vehicle miles per dollar of expense nationwide have declined. And expense per vehicle revenue hour has been increasing for the average system, although it has declined in the Midwest and on the Pacific Coast.[15] The trend could change if these performance measures were supplemented by benefits provided to nonusers, such as cleaner air and reduced congestion.

Detail on trends in labor and capital investment indicate how efficiency has changed over time.

Labor

Between 1975 and 1980, labor productivity, expressed in terms of revenue vehicle miles per employee, declined 10 percent after having dropped 9 percent between 1970 and 1975. Labor productivity has declined another 3 percent since 1980.[16] Overall, labor productivity declined from nearly 14,000 vehicle miles per employee in 1965, to under 11,000 in 1983.

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[14] Kirby and Reno, *The Nation's Public Works: Report on Mass Transit*, op. cit. p. 2.

[15] Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions*, p. 101.

A breakdown of the UMTA data by region, urbanized area, size and mode shows that declines in labor productivity have been nearly universal since 1980, with the exceptions of the Midwest and urbanized areas with populations between 500,000 and 1,000,000.

The productivity of maintenance mechanics declined between 1980 and 1984.[17] Rapid rail showed some improvement in maintenance mechanic productivity from 1980 to 1983, but declined in 1984.

Capital

Many, if not most, cities have too many buses (Exhibit A-18). Federal capital grant programs provide capital funding on an 80 percent federal versus 20 percent local basis, which is an incentive for transit systems to acquire new vehicles, rather than maintain a smaller rolling stock of older ones.

Comparing active vehicles to the number required to serve peak period demand shows whether transit is over capitalized in rolling stock. Nationwide, this ratio was roughly 1.5 in 1984. Excluding the West, the ratio has increased since 1980 in all classes of urbanized areas, including areas with and without rail. UMTA believes that a 20 percent reserve is adequate to ensure reliable peak service,[18] implying that the overall bus fleet could decline by 20 percent[19] without serious harm to the level of peak-period bus service.

Whether service expansion for modes on fixed guideways has been excessive is difficult to judge. Effective measures of over-capitalization for track, tunneling, grade separations, power stations, signals, and fare collection systems for heavy and light rail have not been developed.

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[16] U.S. DOT 1987 Status Report, p. 89.

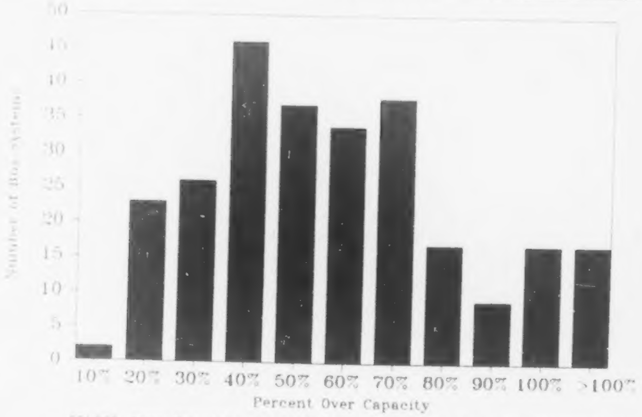
[17] Urban Mass Transportation Administrator, *Compendium of Transit Data for 1984*, op. cit., p. 135.

[18] Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions*, (June 1987), p.101.

[19] Calculated as the "excess" buses (1.5 minus 1.2) divided by the current fleet size: 0.3/1.5 = 0.2.

EXHIBIT A-18

EXCESS BUS CAPACITY IN UNITED STATES CITIES



SOURCE: Apogee Research from Urban Mass Transit Authority, "The Status of The Nation's Mass Transportation," (1987).

AIRPORTS AND AIRWAYS[20]

Since deregulation, airline and airport systems have responded to increased demand and competition with lower fares and more (although not necessarily better) service. Significantly, this growth has not meant increases in physical capacity at commercial airports. However, projected long-term growth in demand suggests that long-term capacity may present the biggest problem in the aviation system. The number of commercial airports, for example, has changed little in recent years. Thus, in order to absorb the rapidly increasing demand for service—as reflected by passenger enplanements—commercial airports have had to add capacity through more runways, improved air traffic control, and better demand management.

Significantly, while total public spending for aviation has risen considerably since 1960 (in constant dollars), total public spending relative to air travel has fallen from a high of 80 cents per passenger-mile to its current level of 20 cents per passenger-mile (Exhibit A-19). This fall could be due to a variety of factors, including a rapid rise in passenger-miles, a peak in public sector investment as the aviation industry begins to mature, and operational efficiencies realized through economies of scale.

System Overview

The aviation system is composed of airports, air traffic control facilities, and aircraft. These components are discussed in detail below.

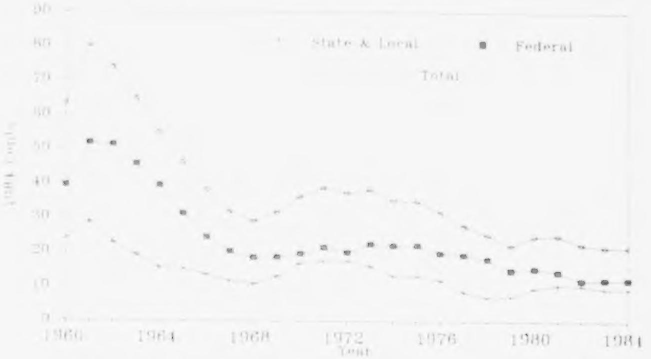
Airports

The U.S. has 16,300 airports, more than the rest of the world combined. Most serve small planes (defined as general aviation) exclusively, and 64 percent (or 10,400) are not available for use by the general public. The 5,900 that are open to the public include all airports used by the commercial aviation industry and most of the largest general aviation airports.

General aviation traffic exceeds commercial airline traffic at almost every airport smaller than a large FAA hub and at many large hubs as well. Overall, there are five times as many general aviation

EXHIBIT A-19

PUBLIC SPENDING FOR AVIATION
PER BILLION REVENUE PASSENGER MILES



SOURCE: Apogee Research, Inc., from the U.S. Bureau of the Census, and U.S. Department of Transportation data.

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[20] This section is drawn from Apogee Research, Inc., "A Consolidated Performance Report on the Nation's Public Works," prepared for the National Council on Public Works Improvement, and Apogee Research, Inc., *The Nation's public Works: Report on Airports and Airways*, (Washington DC: National Council on Public Works Improvement, May 1987).

operations at small hubs than there are air carrier takeoffs and landings.[21]

Most general aviation traffic is handled by a relatively small number of general aviation airports. Indeed, in terms of the number of takeoffs and landings, some of these airports are among the busiest in the nation. General aviation airports in Santa Ana and Van Nuys, California ranked as the fifth and sixth busiest airports in the country in 1985.

Air Traffic Control

The FAA operates a series of facilities, including 399 airport control towers located in the busiest airports, 22 en-route centers to manage the flow of aircraft between airports, and 302 flight service stations that provide weather and related information to general aviation pilots. Air traffic controllers located in the en-route centers and airport towers monitor and direct all aircraft in the vicinity of airports with traffic control towers. A key part of this system is a network of radar, computers, and other equipment designed to monitor aircraft. The Department of Defense operates many of its own control towers, but uses the FAA system for most en-route traffic.

Aircraft and Airlines

Aircraft make up the final part of the aviation system. Unlike the airports and air traffic control system, these are almost exclusively owned and operated by private firms or individuals with the exception of military and other public use aircraft. Private aircraft include three distinct types: the large commercial aircraft that can carry 400 or more passengers and are the mainstays of the large national and international *air carriers*, smaller commercial craft that can be used by *commuter airlines and air taxis* to carry 10 to 60 passengers between smaller airports and the larger primary airports, and *general aviation* planes that typically carry less than ten passengers and are owned by individuals and private firms. The vast majority (99 percent) of aircraft are small planes owned by individuals and corporations.

The private portion of the industry—airlines, general aviation and aircraft manufacturing—totals some $74.5 billion a year in revenues. Added to this is $8.2 billion in spending by the different levels of government to operate, maintain, and build the nation's airports and air traffic control system. The ratio of private to public spending, about 9 to 1, shows the importance of making sure that the public funds are spent on projects of the highest priority, that the overall level of spending is efficient, and that private and public investment is well coordinated. System-wide measurement of aviation performance is one way to encourage this efficiency.

Physical Assets

Physical assets in airports are quantified based on the growth rate in airport facilities and net capital stock.

Airports

Although comparatively unsophisticated, one measure of change in aviation system physical assets is the growth of airports. Since the early 1960s, the total number of airports has grown by an average of 2.8 percent per year, to more than 16,000. While this upward trend continues, the rate of growth has begun to slow. In the last five years, the number of airports has grown by an annual rate of only 1.5 percent. This slowing is directly related to the decline in the number of public-use airports—a drop of 20 percent, from 7,200 in 1969, to 5,800 today. Over that same period, private-use facilities have increased 180 percent, to over 10,000.[22] This divergence has translated into an ever-increasing demand on a diminishing number of public-use facilities.

Net Asset

Net capital assets represents the depreciated value of aviation capital structures. It measures the accumulation and impact of aviation capital stock over time.[23]

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[21] Federal Aviation Administration, "Terminal Area Forecasts: Summary of Traffic and Activity by Hub Size" (February, 1987), p. 5.

[22] The fastest growing subset of this category is heliports, STOL-ports (short take off and landing), and seaplane bases.

[23] Public sector data are derived from U.S. Department of Commerce, Office of Business Analysis, in *Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services*, a report to the National Council on Public Works Improvement (1987). Private sector data are from John C. Musgrave, *Survey of Current Business*, "Fixed Reproducible Tangible Wealth in the U.S., 1982-1985," pp. 36-39.

The key observation is that aviation assets for public and private investment have been strikingly similar, both in level and in rate of growth (Exhibit A-20). Recently, private investment has shown a slight increase following deregulation, a factor that likely reflects demand as new carriers entered the market, others expand service into new markets, and fare wars encouraged a surge in travel. Further, since private sector spending in the aggregate is much greater than that of the public sector, the similarity in net capital stock reflects both the fact that a large portion of private expenditures is dedicated to operating costs and that much of private capital outlays is for investments with a shorter useful life than those of the public sector (e.g., aircraft versus runways).[24]

The similarity in growth is also significant because, even after adjusting to constant dollars, both public and private sector investment have continued to increase. The trend for private sector investment, in particular, however, is one of a slowing growth rate, while public sector assets have continued to grow at a steady rate.

Service Delivery

Data on airline performance and service levels are perhaps the best indicators available of exactly how well the aviation system works. All airlines are required to file financial, operational, and service data with the Department of Transportation's Research and Special Programs Administration.[25] These filings serve as the basis for calculating enplanements, passenger-miles, and financial performance measures.

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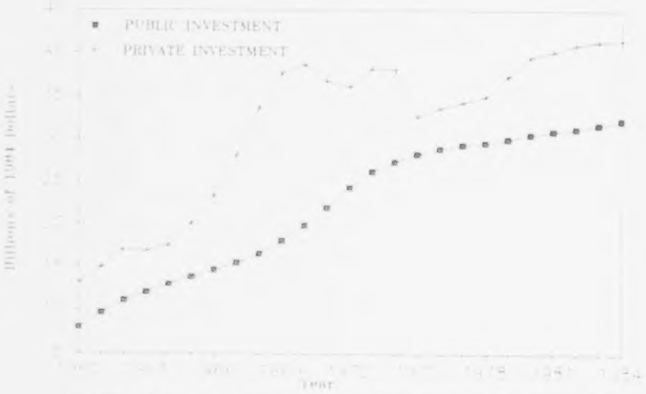
[24] See, for example, Apogee Research, Inc., *The Nation's Public Works: Airports and Airways*, p. 9.

[25] Known as "Form 41" filings, the data they provide are compiled in a variety of Civil Aeronautics Board (prior to 1978) and Research and Special Programs Administration (Post-1978) documents.

EXHIBIT A-20
NET CAPITAL STOCK IN AVIATION



SOURCE: U.S. Department of Commerce, Office of Business Analysis and John Musgrove, Bureau of Economic Analysis.

Enplanements, specifically revenue-passenger enplanements, serve as one overall indicator of service on the part of airlines, airports, and air traffic control (Exhibit A-21).[26] Since 1965, enplanements have grown continually, from 100 million, to nearly 320 million in 1979. Between 1979 and 1981 there was a decline in enplanements because of recession, high fuel costs, and the controllers' strike. Since 1981, enplanements have grown rapidly, surpassing 1 million a day in 1985.

A closely related but more comprehensive measure of system output is revenue passenger-miles (RPMs). A RPM is defined as one revenue passenger transported one mile. Since 1960, the number of RPMs has increased rapidly. Further, as enplanements slumped briefly in the early 1980s, so too did RPMs. Both domestic and international RPMs have increased at about 9 percent per year since 1960.

Service to Airlines and Pilots

Data on the number and type of operations at FAA-controlled towers indicate that the air traffic control system has been able to handle increased system demand. However, the total number of operations has yet to reach pre-strike levels.

The first significant drop in general aviation operations came immediately following the strike in 1981. The decline can be attributed to a number of factors including: increased costs, cheaper commercial fares, and reductions in air traffic control support. Of the nearly 11,000 reductions in operations at FAA towers, 96 percent was absorbed by general aviation flyers. Commercial air carrier traffic on the other hand, absorbed only 4 percent.[27] Since then, air carrier traffic has risen rapidly in response to deregulation, lower fuel costs, and burgeoning demand.

Quality of Service

Passenger delays and safety are perhaps the two most important measures of service quality—delays because they translate directly into lost economic productivity and safety because it has always been the most dramatic sign of failure. In addition, airport accessibility is included as a key determinant in the value and scope of service provided.

Delays

For most travelers, delays are the most annoying single feature of air travel today. The economic and personal costs of delays are substantial, with estimates of

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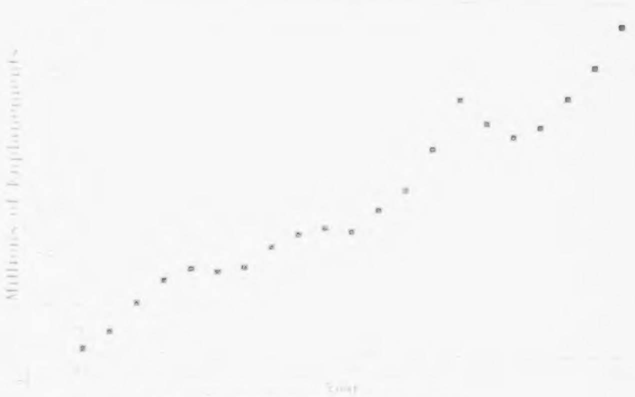
[26] Revenue passenger enplanement is the total number of revenue-generating passengers boarding aircraft, including originating, stopover and transfer passengers.

[27] Air taxi flights actually show a slight increase during this same period, and military flights a slight decline.

EXHIBIT A-21
REVENUE—PASSENGER ENPLANEMENTS



SOURCE: Civil Aeronautics Board and Federal Aviation Administration.

costs to the airline industry alone exceeding $1 billion a year.[28] Measuring delay and assigning cause, however, can be difficult, since delay is ultimately a function of airline scheduling, airport capacity, air traffic control capacity, and weather. Further, two different ways exist to consider the impact of delay—as loss to the air carrier, or as loss to the passenger.

The FAA only estimates air carrier delays. Until recently, two systems were used to estimate delays. The first is that of the air traffic control system, which tracks all carrier delays over 15 minutes attributable to the air traffic control system. The second system, maintained by FAA's Office of Aviation Policy and Plans, tracks all air carrier delays longer than one minute by phase of flight.

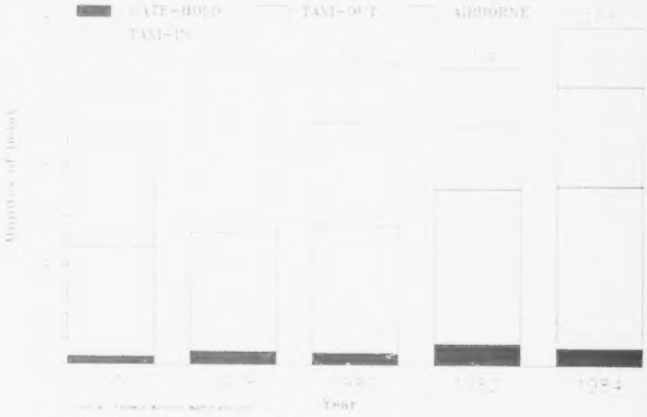
Estimates generated by the first system attribute weather as the cause of two-thirds of all delays, the remaining one-third being split between airport congestion and control center volume constraints. The second system of measuring delays indicates that over the last eight years, *the growth in the average air* carrier delay has been minimal (2.4 minutes) (Exhibit A-22). In addition, only one phase, taxi-out, has grown significantly following deregulation, while airborne delays have fallen. This trend suggests that air traffic control has been holding flights at the airport in lieu of sending them to face airborne delay.

Recently, major air carriers have been required to report all delays of more than 15 minutes, with the exception of delays due to mechanical difficulties, to the FAA. To aid air travel consumers, the FAA issues a monthly report on the delay record of each airline and requires that the delay records of individual flights are shown on airline computer reservation systems.

The FAA does not track passenger delay. However, since the majority of passenger travel is during peak periods when most delays occur, passengers often suffer delays greater than average air carrier delay information would suggest. Clearly, passenger delay information is needed in order to establish the impact

EXHIBIT A-22

AIRCRAFT DELAYS BY STAGE OF FLIGHT



SOURCE: Federal Aviation Administration

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[28] Office of Technology Assessment, Airport System Development (August 1984), p.9. The current Air Transport Association estimate is $1.5 billion plus an equal loss due to travellers' delays.

and demonstrate the ultimate cost of delays on service beneficiaries.

Safety

Safety is a key motivating factor behind federal involvement in aviation. This is partly due to the dramatic nature of many aviation accidents. In fact, when accident rates are adjusted for the passenger-miles of travel, commercial aviation's safety record exceeds that of almost every other mode of transport. The record for general aviation, on the other hand, is much less commendable.

Since 1967, the number of fatal air carrier accidents has declined, despite rapidly rising passenger traffic (Exhibit A-23).[29] Even so, many industry analysts are calling for more extensive monitoring to ensure continued levels of safety.[30] Much of this interest is motivated by concern that market pressures have encouraged air carriers to pay less attention to maintenance. Although many studies are underway (including, for example, one by the Office of Technology Assessment) no clear evidence is yet available to confirm this speculation.

Investment Efficiency

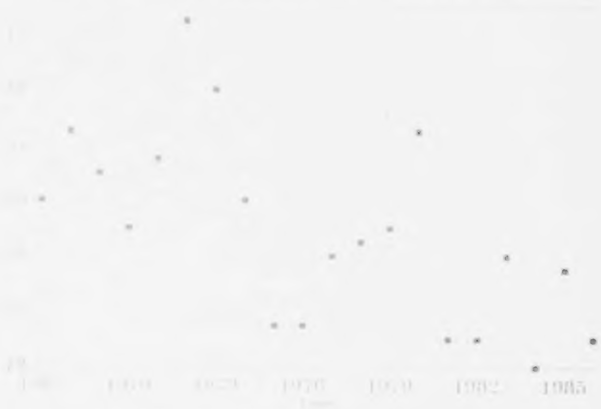
Investment efficiency must be measured relative to objectives. Aside from profits, private sector aviation investment is generally intended to result in service improvements. Public sector investment, on the other hand, is generally intended to enhance safety (air traffic control) and encourage an effective national air transportation system (targeted capital investment).

Airports and Airlines

Private sector efficiency is measurable both as a function of airplane use rates (load factors), and on the basis of revenues per unit of service provided. Revenues per passenger-mile are used as a broad indicator of efficiency. Trends in load factors indicate a high degree of sensitivity to federal regulation. Trends in revenues per passenger-mile, on the other hand, show the results of improved operating efficiencies and greater competition.

The passenger load factor is the ratio of passenger miles to available seat-miles, or the average fraction of seats filled. Based on this measure, the use rates of aircraft, both domestic and international, have risen dramatically since reaching their nadir in the early 1970s (Exhibit A-24), suggesting a correlation between the end of federal regulation in 1978 and increased load factors. This indicates that investment efficiency improved markedly as higher competition

EXHIBIT A-23
TOTAL FATAL ACCIDENTS OF AIR CARRIERS WORLDWIDE



SOURCE: Aviation Week and Space Technology

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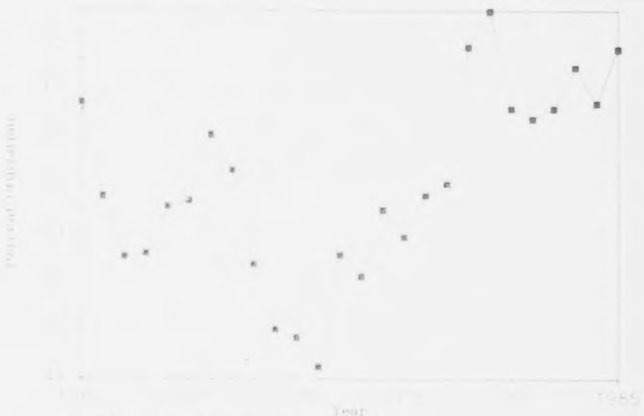
[29] World-wide fatal accidents are used to reflect aggregate trends. These trends are demonstrated less clearly by domestic data since, over time, the number of U.S. air carrier accidents relative to traffic is statistically insignificant.

[30] For more detailed discussion of specific proposals, see *Aviation Week and Space Technology*, "Safety Experts Cite Need for Increased Monitoring," July 13, 1987, p. 45.

EXHIBIT A-24
REVENUE PASSENGER LOAD FACTOR



SOURCE: Civil Aeronautics Board and Federal Aviation Administration.

demanded more efficient use of available capacity. However, load factors cannot continue to increase without negative ramifications because of the normal imbalance in air traffic flows (i.e., peak versus nonpeak period loads) and because passengers value the quality of service as well as cost.[31]

Revenues per passenger-mile is an alternative measure of efficiency based on gross industry revenues and revenue passenger-miles flown.

Revenues per passenger-mile in nominal dollars jumped following deregulation in 1978 (Exhibit A-25). However, in constant dollars, they have continued to decline since 1960. In part, this decline is a result of increased operating efficiencies possible through improved technology (large aircraft and computer reservation service, for example) and service (use of hub and spoke systems to improve aircraft use). After 1978, however, this number also reflects a drop in real labor costs, higher degrees of competition, and lower fuel costs.

Air Traffic Control

For the air traffic control system, no time series data exist to assess efficiency. In fact, very little information is available to analyze historical, or project future, efficiency. Thus, while it is known that spending peaked in the early 1970s and is on the rise again, little can be said about the ultimate benefit of that investment. A Congressional Budget Office (CBO) analysis conducted at the time of rejuvenated federal funding for air traffic control facilities demonstrated the potential for a 2.3 to 1 benefit-cost ratio—assuming that construction deadlines were met.[32] This study also showed the potential for a 24 percent annual rate of return on increased investment in air traffic control.

More recently, however, National Airspace System Plan outlays have begun to rise above projected levels as programs take longer to implement than anticipated, reducing the expected effectiveness of the investment. One recent analysis estimated that the overall ratio of benefits to costs had dropped to 1.5—well below the original Congressional Budget Office projections.[33] While still positive, this indicates that a reevaluation may be necessary, particularly for those components of the investment plan that were of marginal quality before deadlines began to slip.

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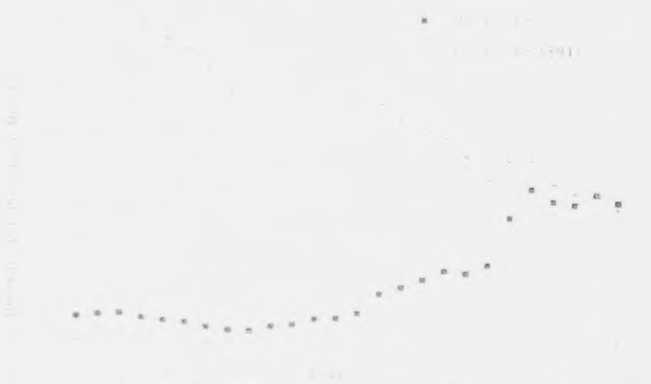
[31] For a more detailed discussion of optimal load factors, see Steven Morrison and Clifford Winston, *The Economic Effects of Airline Deregulation*.

[32] Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan*, August 1983.

EXHIBIT A-25
AIRLINE REVENUES PER PASSENGER-MILE



SOURCE: Apogee Research Inc., from the Civil Aeronautics Board and the U.S. Department of Transportation

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[33] Apogee Research, Inc., *The Nations Public Works: Airports and Airways*, op. cit., p. 70.

PUBLIC WATER SUPPLY[34]

The overall goal of a water supply system, whether public or private, is to deliver sufficient quantities of water at suitable pressures for consumption and fire protection at the minimum cost. In addition, the supply should meet quality demands for various uses such as residential, commercial, or industrial applications.

Water supply is provided at the local or regional level by a series of disparate entities. These community and regional systems are developed, owned, and operated by various government (public) agencies or investor (private) groups. Other commercial concerns such as trailer parks or hospitals often supply water as an ancillary service. (Exhibit A-26)

Physical Assets

Despite their simplicity, physical assets of water systems are difficult to evaluate at the national level. They vary greatly from one system to another in terms of quantity or size, strength, age, and relative efficiency. To the extent they are available, good records are kept only at the community or utility level. At the national level, readily measurable indicators include number of systems, net depreciated capital assets, treatment plant capacity in million gallons per day (mgd) per 1,000 persons served, and distribution storage capacity, also in mgd per 1,000 persons served.

Numbers of Systems

Based on a 1982 survey of about 1,000 community water systems serving from 25 to over 1 million year-round residents, the EPA Office of Drinking Water estimated that 59,071 water supply systems served the nation. Exhibit A-26 presents the distribution of water systems by the type of populations they serve. The vast majority of systems are small in size. Eighty-eight percent of all systems serve less than 3,300 people each and supply only 11 percent of the total population served by all public systems. A very small percentage of systems (0.5 percent) serve more than 46 percent of the centrally served population.

Net Depreciated Capital Assets

The U.S. Commerce Department has estimated the net depreciated capital stock of water supply facilities nationwide.

EXHIBIT A-26

1986 WATER SUPPLY SYSTEMS

Percent of Population

NOTE: 88 Percent of Systems Serve Less than 3 Percent of the Population; 0.5 Percent of Systems Serve More Than 46 Percent of the Population.

SOURCE: U.S. Environmental Protection Agency

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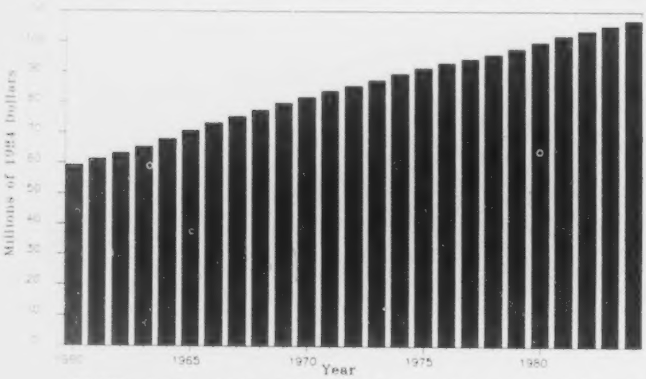
[34] This section is based on Apogee Research, Inc., *A Consolidated Performance Report On The Nation's Public Works*, prepared for the National Council on Public Works Improvement, August 1987, and Wade Miller Associates, Inc., *The Nation's Public Works: Report On Water Supply*, prepared for the National Council on Public Works Improvement, May 1987.

EXHIBIT A-27
NET DEPRECIATED WATER SUPPLY ASSETS



SOURCE: U.S. Department of Commerce, Office of Business Analysis, "Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services," prepared for the National Council on Public Works Improvement, 1987.

They have assumed a fifty-year average life and measured changes in stock levels over time (construction of new sources of supply, treatment facilities, and distribution lines), net of their depreciation.[35] These data indicate a steady build-up of facilities over the entire period of investigation (Exhibit A-27). From just under $60 billion in assets in 1960, water supply capital stock grew by an average of 2.5 percent a year to about $108 billion by 1984. This represents a 37 percent increase in assets per person, from $332 dollars in 1960, to $455 per person in 1984.

Treatment and Distribution Capacity

Treatment plant capacity measures the capability of water systems to meet the overall needs of service area populations. Distribution storage capacity is a measure of readily accessible reserves of finished water. Such reserves are important for dealing with unexpected, intensive water requirements such as fire fighting or alleviation of hazardous material spills. Treatment plant and distribution storage capacity estimates were calculated for 1981 and 1984 (Exhibit A-28).[36] On average, the capacity of the nation's water treatment facilities remained about the same between 1981 and 1984. Storage capacity per person, on the other hand, declined by one-half, from 0.39 mgd per 1,000 persons served in 1981 to 0.19 mgd per 1,000 persons in 1984.

Service Delivery

Service delivery may be defined in terms of water production and delivery. According to the 1984 American Water Works Association (AWWA) survey, 430 utilities in 50 states produced a combined annual total of over 6.5 trillion gallons of water. This corresponds to roughly 120-150 gallons of finished water per capita per day.

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[35] Depreciation as used here is an accounting concept only. It does not imply that physical facilities will deteriorate and require replacement after 50 years. In fact, partly because of proper maintenance, some water distribution facilities built at the turn of the century are still in service today. See U.S. Department of Commerce, Office of Business Analysis, *Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services*, prepared for the National Council on Public Works Improvement, (1987).

[36] *American Water Works Association Surveys*, 1981 and 1984.

EXHIBIT A-28

TREATMENT PLANT AND DISTRIBUTION STORAGE CAPACITY IN 1981 AND 1984

(millions of gallons per day per 1,000 persons served)

	1981[a]	1984[b]
Treatment Plant Capacity		
Average	0.403	0.395
Highest	1.170	0.740
Lowest	0.180	0.100
Storage Distribution Capacity		
Average	0.39	0.19
Highest	2.09	0.55
Lowest	0.01	0.05

[a] Sample size = 1,397

[b] Sample size = 430

Sources: American Water Works Association, *1981 Water Utility Operating Data*, Denver, Colorado, 1981, and American Water Works Association, *1984 Water Utility Operating Data*, Denver, Colorado, 1984.

Delivery statistics are not readily available due to the difficulty of estimating delivery in unmetered areas. In absolute terms, insufficient service delivery is not a problem at the national or state level. Local delivery failures result from the disruption of individual systems and may affect all or part of the related service area.

Quality of Service

The most important factors underlying the quality of the water supply service in the United States are the continuity of supply and the delivery service's compliance with federal drinking water standard.

It is difficult, however, to make general statements about the current quality of the nation's water systems since there is a clear division between the status of small, rural systems and large, urban systems. In the small systems category, many problems exist, and these are partially reflected in EPA's fiscal year 1985 status report dealing with small systems. EPA data show that of 728 persistent violators of the microbiological maximum contaminant level (MCL), 630 (86.5 percent) occurred in very small systems (those serving fewer than 500 persons). By contrast, only five persistent violators were found in systems serving 25,000 or more persons. In the categories of turbidity violations (suspended solid matter) small systems also constitute a large percentage.[37]

Large system problems also cover a broad spectrum. It is well known, for instance, that a number of older systems, particularly in the Northeast and Midwest, have deteriorating capital facilities. Distribution systems, which are not visible, tend to represent the largest component of "deferred maintenance" or "rehabilitation needs."

Potable water is essential and the need for continued supplies is paramount. Interruptions in supply, measured by frequency, duration, cause, and number of persons affected, would constitute primary indicators of the quality of service. Unfortunately, such indicators are unavailable.[38]

Compliance With Drinking Water Standards

In 1984, 90 percent of all public systems consistently met EPA's standards for maximum allowable levels of bacteria in finished water and 97 percent met standards for turbidity.[39] These figures represent little change in water purity, on average, since EPA's first analysis in 1981.

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[37] Wade Miller Associates, Inc., op. cit., p. 25.

[38] George E. Peterson, Mary John Miller, Steve Godwin, and Carol Shapiro, *Benchmarks of Urban Capital Condition*. Draft project report, The Urban Institute, Washington, DC (February 1983).

They do indicate broad compliance with existing federal standards. But federal health standards do not yet exist or have not yet been fully implemented for many synthetic organic compounds and other contaminants found in drinking water. In growing numbers of cases when drinking water supplies (mostly from groundwater) have been tested, these compounds and other chemical contaminants have been found at high levels.[40] Removing these compounds as is mandated by the 1986 amendments to the Safe Drinking Water Act (SDWA) will be expensive. Even before accounting for SDWA requirements, local entities currently pay $70 million annually to meet federal regulations. EPA estimates that the SDWA amendments will impose approximately $5.5 billion in capital costs on the drinking water industry.

Incidence of Disease

An examination of the incidence of waterborne disease may indicate the nature and frequency of service quality failures. A 1973 review of the incidence of disease attributable to public water supplies in the United States over the period 1946-1970,[41] indicates 357 outbreaks of various water-borne diseases. The single largest cause (53 percent) of disease outbreaks was the contamination of source water in systems delivering untreated water. Other causes were categorized as distribution system deficiency (17 percent), miscellaneous reasons (16 percent), inadequate treatment of supplies (12 percent), treatment process overwhelmed by source contamination (1 percent, and storage facility deficiency (1 percent). Between 1970 and 1980, an additional 315 outbreaks of waterborne disease occurred. This could indicate an increase in the incidence of disease over time.[42] However, it is not clear whether this is due to increased reporting of outbreaks or an increase in actual outbreaks.

Unaccounted-For Water

Unaccounted-for water measures the overall efficiency of the delivery process by indicating the difference between the amount of water purchased or produced and the amount sold to utility customers. It is often expressed as the ratio of unaccounted-for water to total production. Unaccounted-for water should not be interpreted as an indicator of physical efficiency alone because it involves several disparate factors such as system leakage, inaccurate meters, theft, accounting problems, and foregone water sales or revenues. Acceptable rates of unaccounted-for water range from 10 to 20 percent of total production. On the average, unaccounted-for rates are much higher in severely distressed and declining cities (particularly those in the Northeast), while younger cities and cities in the arid West have lower rates.[43]

In a 1981 AWWA survey of 573 water utilities, unaccounted-for system losses averaged 13 percent of total water produced.[44] This is well within the range acceptable to the water industry.

Water Main Breaks

Although the terms are often used interchangeably, water main breaks differ from leakage. Main breaks involve cracks or tears in the main itself while leaks occur at joints connecting the mains. A main breakage rate expressed as the number of breaks per 1,000 miles of distribution line is frequently used to compare systems of varying sizes.

An average of 229 breaks per 1,000 miles of main occurred in 34 U.S. cities from 1978 to 1980.[45] A large number of breaks indicates a problem but does not indicate that the system is uniformly weak. The causes of breaks include severe weather, rapid changes in seasonal temperatures, ground movement,

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[39] Environmental protection Agency, *Fiscal Year 1984 Status Report: The National Public Water System Program*, prepared by the Office of Drinking Water, 1985.

[40] Council on Environmental Quality, *Contamination of Groundwater by Toxic Organic Chemicals* (January 1981).

[41] Gunther F. Craun and Leland J. McCabe, "Review of the Causes of Waterborne Disease Outbreaks," *Journal of the American Water Works Association*, Vol 65, No 1, pp. 74-84 (1973).

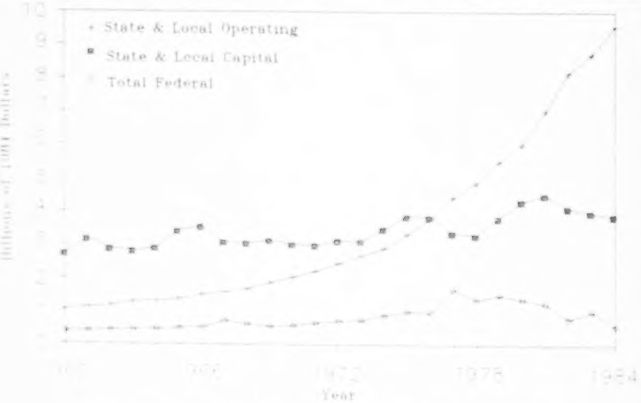
[42] Edwin C. Lippy and Steven C. Waltrip, "Waterborne Disease Outbreaks—1964-1980: A Thirty-Five-Year Perspective," *Journal of the American Water Works Association*, Vol 76, No 2, pp. 60-67 (1984).

[43] Peterson, et al., *Benchmarks* (1983).

[44] AWWA, *1981 Survey* (1981).

[45] Peterson, et al., *Benchmarks* (1983).

EXHIBIT A-29
GOVERNMENT SPENDING FOR WATER SUPPLY



SOURCE Apogee Research Inc from published and unpublished U.S. Bureau of the Census data

corrosive soils, and damages resulting from other utility or construction activities.

Main failures do not always increase with the age of the system, although the literature is inconclusive on this issue. A study done by the New York District of the U.S. Army Corps of Engineers on the underground water distribution facilities in Manhattan indicated that the age of the mains was not a major factor. The study found that the primary causes of main breaks were location and prior leakage that eroded the bedding.[46] However, a study discussed in the same report found that the age of metallic pipes was an important factor in determining both the time elapsed to the first repair and the number of breaks.

Investment Efficiency

Due to the varied nature of water system ownership and operation, there are few indicators of investment efficiency that may be readily collected and evaluated at the national level. Consequently, water systems were evaluated on the basis of total revenues, total operating costs, total capital costs, and total costs of servicing the system's debt.

In a recent analysis conducted at the individual utility level, the rate of return on invested capital for a sample of 30 California municipal water districts for 1970-1982 varied from less than 2 percent to 14 percent.[47] If 10 percent is taken as the opportunity cost of capital (the rate that competing capital investments would earn), 25 of the 30 districts invested inefficiently. In fact, half the sample earned less than 5 percent. Low average water prices were the primary causes of the lowest rates of return. The authors suggested raising water rates to earn at least 10 percent on invested capital.

During the period 1960-1984, local governments provided about 90 percent of total expenditures on public water supply, state governments provided 2 percent, and the federal government provided 8 percent (Exhibit A-29). In recent years, however, the state role has increased while the federal role has decreased. In 1984, for example, the local contribution covered all operating expenses and 66 percent of capital costs (89 percent of total outlays). The states financed 21 percent of capital expenses (7 percent of total outlays) and the federal government financed the remaining 13 percent of local capital outlays (4 percent of total spending).

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[46] Thomas M. Walski and Anthony Pelliccia, "Economic Analysis of Water Main Breaks," *Journal of the American Water Works Association*, Vol 74, No 3, pp. 140-147 (1982)

[47] Lloyd J. Mercer and W. Douglas Morgan, "The Efficiency of Water Pricing: A Rate of Return Analysis for Municipal Water Departments," *Water Resources Bulletin*, (April 1986), Vol 22, No 2, pp. 289-295

While federal capital outlays for water supply have declined significantly since peaking at $ 1.7 billion in 1977, state and local capital spending has remained relatively steady between $3.0 and $4.5 billion a year since 1960. After adjusting for inflation, operating expenses have grown at a rapid rate—about 9.6 percent a year—from about $1 billion in 1960 to over $9 billion in 1984, largely a result of population growth and the increasing real costs of energy and chemicals.

WASTEWATER TREATMENT[48]

Wastewater treatment facilities remove wastes from water used by individuals and by commercial and industrial establishments before it is returned to the natural environment. These facilities protect public health and the environment and encourage economic development.

Available data show conflicting trends in the historical performance of wastewater treatment facilities. The volume of wastewater treated in the United States has increased by almost one percent a year since 1976, while the dollar value of the asset base has been expanding by 4.4 percent a year since 1960. Part of this expense can be attributed to an increase in the level of service. Between 1978 and 1986 the share of wastewater treated at a secondary level or better increased from 68 to 82 percent. Increases in treatment plant reserve capacity have also added significantly to the asset base.

During the 1970s and early 1980s, trends suggest that ambient water quality has remained the same despite population and industry growth. Such growth and emerging concerns about non-point sources of pollution, groundwater contamination and threats to wetlands will continue to challenge the nation's commitment to preserving water quality.

Physical Assets

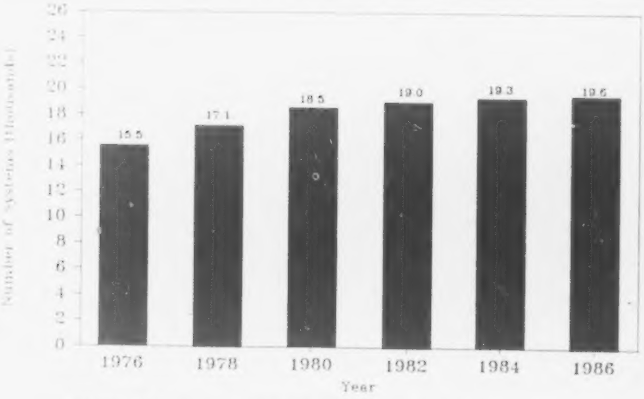
The two broad categories of physical assets for which national data are available are sewer systems (number of systems in operation nationwide), and wastewater treatment facilities (the number of treatment facilities, their design capacity, and the population served, all by treatment level). Physical assets represent the most direct measure of the extent to which the nation is meeting the literal statutory mandate for minimum wastewater treatment facilities.

Sewer Systems

Over the past 10 years, the number of sewer systems has grown by about 26 percent (Exhibit A-30). Similar growth trends are seen in the number of treatment plants and in the capacity of these

EXHIBIT A-30

TOTAL WASTEWATER COLLECTION SYSTEMS



SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various years.

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[48] This section is based on information contained in two studies: Apogee Research, Inc., "A Consolidated Performance Report On The Nation's Public Works," prepared for the National Council on Public Works Improvement, August 1987; and Apogee Research, Inc., *The Nation's Public Works: Report On Wastewater Management* (Washington, DC: National Council on Public Works Improvement, 1987). Both reports rely on EPA Needs Survey data. However, EPA has used various methods over the last ten years in collecting these data. As a result, data may not be fully comparable over time.

plants. The number of sewer systems only roughly tracks the total growth in wastewater treated, however, since a single system can convey varying wastewater flows. Also, multiple sewer systems can serve a single treatment plant.

Treatment Facilities

The total number of treatment plants has grown by about 17 percent since 1976 with the largest percentage jump (15 percent) occurring between 1976 and 1980 (Exhibit A-31). This corresponds to the peak period in total public expenditures for wastewater treatment.

Overall capacity of treatment plants increased 14 percent over the period 1978-1986 (Exhibit A-32). Half of that growth (7 percent) came in a 2-year period between 1978 and 1980. From 1980 to the present, growth has averaged only 1.1 percent a year. The high growth in total plant capacity between 1978 and 1980 resulted from the construction of large facilities and the construction of a large number of facilities (corresponding to the peak in funding in 1979).

While both the total number and capacity of treatment plants have been increasing over time, the number and capacity of treatment plants that only treat waste to the primary level have been declining. This result is consistent with the national goal of bringing all treatment plants to secondary treatment level or better.

Net Depreciated Capital Stock

The net depreciated stock of wastewater treatment capital facilities grew steadily by about 4.4 percent a year from a little over $49 billion in 1960 to more than $136 billion in 1984 (Exhibit A-33).[49] The fastest growth in stock occurred between 1963 and 1965—about 5.4 percent a year. Growth rates slowed to less than 3 percent in 1982, 1983 and 1984. This overall trend indicates that new additions to wastewater treatment capital stock (treatment plants plus conveyance facilities) has outpaced the depreciation of existing plant and equipment.

Service Delivery

Service delivery measures include the population served, the volume of wastewater treated, and the reserve capacity available to serve future populations.

Population Served

One way to view the service levels of wastewater treatment and the system's ability to meet increasing demand is to measure the population served by centralized treatment. The number of people served grew by 17 percent from 1976 to 1986 (Exhibit A-34). The highest growth rate came between 1976 and 1980, again supporting the conclusion that the system grew in this 4-year period.

These figures include both the resident and the nonresident population served. Resident populations are permanent residents within the service area of the established sewerage authority. Nonresident populations include transients, seasonal workers, commuters, tourists, and other persons who must be served by local systems, but who do not reside within the service area. This composite number reflects the true demand placed on the nation's wastewater treatment systems.

The proportion of the U.S. population served by centralized wastewater treatment facilities grew from 66.7 percent in 1976 to 74.9 percent in 1986 (Exhibit A-35).[50] Moreover, the proportion of the population served by less than secondary treatment facilities has declined over this period. This supports the conclusion that progress is being made toward the national goal of secondary treatment or better.

Volume of Wastewater Treated

The historical trend in the volume of wastewater treated is exhibited in Exhibit A-36. The volume of wastewater treated grew by roughly 8 percent, from 25,535 million gallons per day (mgd) in 1976 to 27,692 mgd in 1986. This represents an average annual growth rate of just over 0.8 percent, compared to population growth of 1 percent annually over this period.

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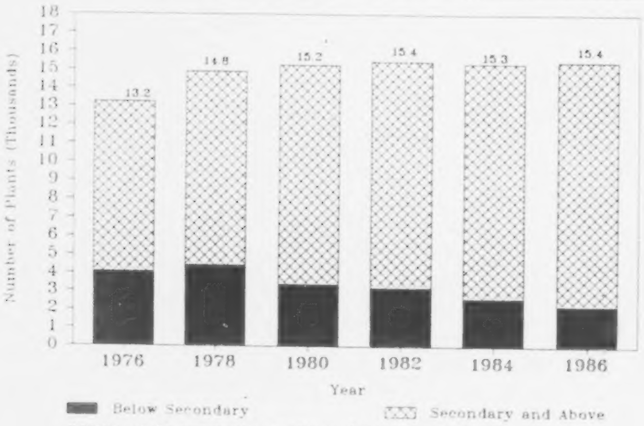
[49] Assumes an asset life of 37 years. See U.S. Department of Commerce, Office of Business Analysis, "Effects of Structural Changes in the U.S. Economy From the Use of Public Works Services," prepared for the National Council on Public Works Improvement (August 1987).

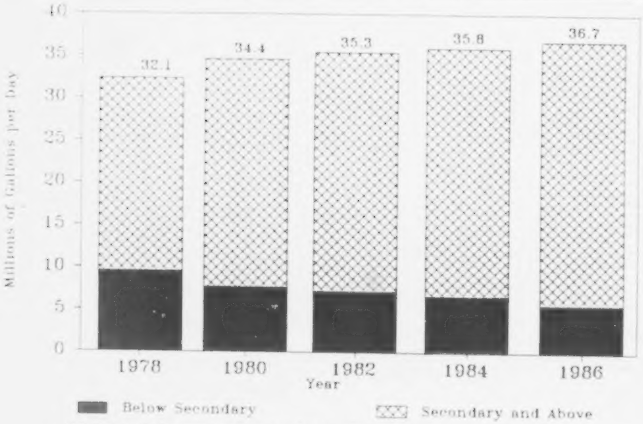
[50] In calculating the percentage of the population served, only resident population figures were used.

EXHIBIT A-31
TOTAL WASTEWATER TREATMENT PLANTS



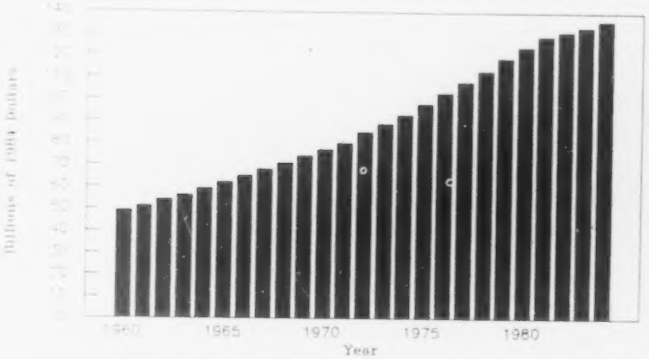
SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various years.

EXHIBIT A-32
CAPACITY OF TREATMENT PLANTS



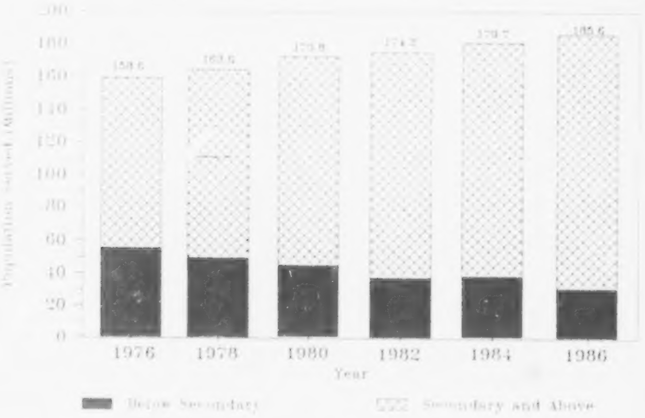
SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various years.

EXHIBIT A-33
NET DEPRECIATED CAPITAL STOCK OF WASTEWATER TREATMENT FACILITIES



SOURCE: U.S. Department of Commerce, Office of Business Analysis, "Effects of Structural Change in the US Economy on the Use of Public Works Services," a report to the National Council on Public Works Improvement, 1987.

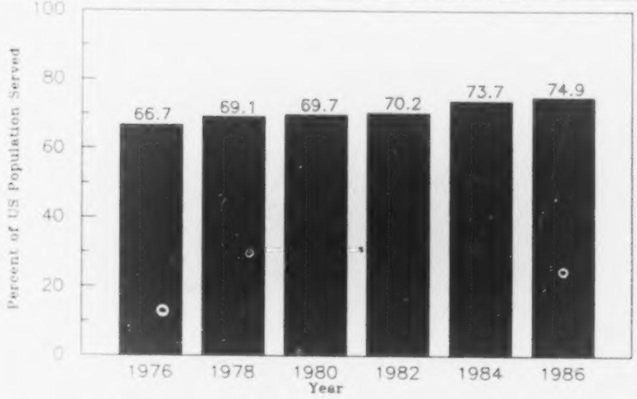
EXHIBIT A-34
POPULATION SERVED BY WASTEWATER TREATMENT PLANTS BY LEVEL OF TREATMENT



SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various data.

EXHIBIT A-35

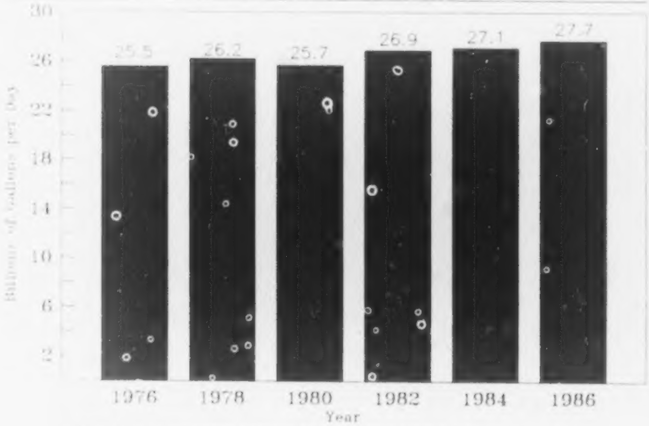
PERCENTAGES OF NATIONAL POPULATION SERVED BY CENTRALIZED WASTEWATER TREATMENT PLANTS



SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various years.

EXHIBIT A-36

VOLUME OF WASTEWATER TREATED



SOURCE: U.S. Environmental Protection Agency, "Biennial Needs Survey," various years.

Reserve Capacity

Reserve capacity is simply the difference between design capacity and the actual volume of wastewater treated. Nationwide reserve capacity jumped by 47 percent, from a level of 5,945 mgd in 1978 (23 percent of total flow treated), to 8,756 mgd in 1980 (34 percent of flow treated). Since 1980, reserve capacity as a percentage of total flow treated has remained steady at around 32 percent.

Quality of Service

Quality of service is made up of two interrelated but distinct components: quality of service to the direct users, and quality of service to the "rest of the world"—as measured by system externalities.[51]

Quality of service to the users is a broad category that includes concerns for reliability, health, safety, environmental impacts, and progress toward meeting national goals. Comprehensive data are not available on the contamination of water supplies (surface water and groundwater) and the impairment of public health from wastewaters, aerosols, and sludges. Nor do statistics exist for the reliability of either wastewater treatment or collection systems at the national level.

Three measures of quality for which data do exist include ambient water quality reviews, facility compliance with effluent limits, and worker safety.

Ambient Water Quality

Two nationwide sampling networks permit nationally consistent analyses of long-term water quality trends at more than 300 locations on major U.S. rivers. These networks—The National Stream Quality Accounting Network (NASQAN) and the National Water Quality Surveillance System (NWQSS)—are operated by the U.S. Geological Survey.

A recent analysis of water quality trends in the nation's rivers, based on NASQAN and NWQSS data from 1974 to 1981, indicates limited improvement associated with the construction of municipal wastewater treatment plants.[52] The study notes widespread declines in fecal coliform concentrations at most locations and some decline in phosphorus.[53] On the other hand, changes in dissolved oxygen (an indicator of decaying organic matter) could be attributed to municipal wastewater treatment in less than 2 percent of all stream segments measured. Overall, stream water quality data are far from conclusive in measuring the progress toward attaining national clean water goals. In fact, a recent report by the General Accounting Office suggested the need for better water quality data to provide the justification for continued large expenditures of public and private funds to control point sources of pollution.[54]

Compliance With Effluent Limits

Reliable national data have only been collected since 1985.[55] Included in these data are measurements of municipal treatment plant violations of BOD,[56] suspended solids, nitrogen, and phosphorus. Exhibit A-37 shows that there is little difference in the number of BOD permit violations between 1985, 1986, and estimated violations in 1987. The number of violating facilities in each of the three periods is roughly equal to one-third of all the facilities operating throughout the country. The benefits and costs of reducing violations, however, cannot be determined with available data.

Worker Safety

The level of safety for wastewater treatment and collection systems covers the occurrence and seriousness of injuries to maintenance workers.[57] The frequency of injuries is a rough indicator of the quality of sewerage structures and, more to the

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[51] An externality, in this context, refers to a benefit or cost imposed on individuals other than immediate consumers and producers of a service that either directly or indirectly results from the provision of that service.

[52] Richard A. Smith, Richard B. Alexander, and M. Gordon Wolman, "Water Quality Trends in the Nation's Rivers," Science vol. 235, p. 1607 (March 27, 1987).

[53] Fecal coliform bacteria concentrations are indicators of the presence of pathogenic bacteria characteristic of municipal wastewater.

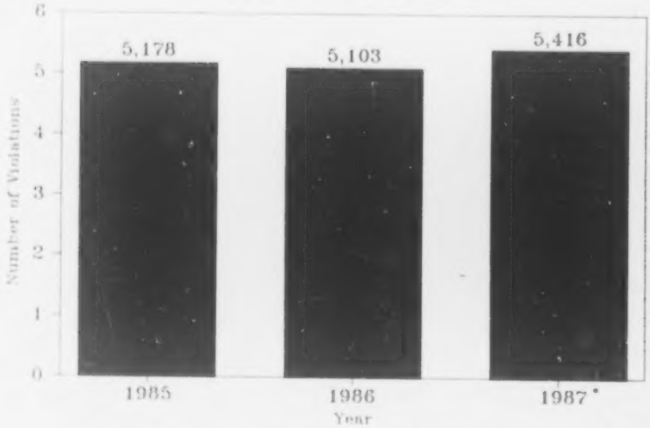
[54] General Accounting Office, "The Nation's Water: Key Unanswered Questions About the Quality of Rivers and Streams," GAO/PEMD 86-6, Washington, D.C. (1986).

[55] The EPA provided a great deal of data from their Performance Compliance System data base. Unfortunately, this is a relatively new initiative that promises to be more useful in the future.

[56] BOD—biochemical oxygen demand—is a measure of bacterial degradation of organic matter in water. As degradation occurs, oxygen is consumed. The higher the BOD, the lower the oxygen concentration in wastewater or streams, and the lower the water quality.

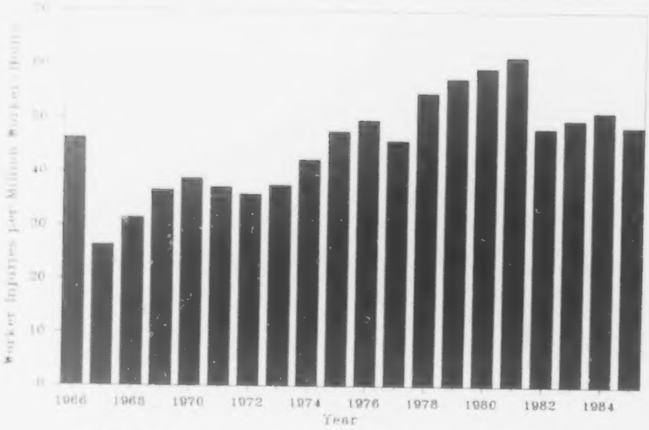
[57] The yearly surveys typically sample about 5 percent of the total population, dating back to 1967. See Samuel J. Hadeed, "Safety Survey," Journal of the Water Pollution Control Federation, 1967-1986.

EXHIBIT A-37
VIOLATIONS OF FEDERAL
BIOCHEMICAL OXYGEN DEMAND STANDARDS



* The number of violations for 1987 is an annualized value based on actual data from the first quarter of 1987
SOURCE: U.S. Environmental Protection Agency Permit Compliance data base

EXHIBIT A-38
SEWER SYSTEM MAINTENANCE WORKER INJURY RATE



SOURCE: Water Pollution Control Federation point, the quality of labor associated with sewer system maintenance. The injury frequency rate is the number of worker injuries occurring per million man-hours of labor; the severity rate is equal to the number of days lost from work per million man-hours of labor.

From 1966 to 1985 injury frequency rates generally increased. The high was 61.64 injuries per million worker hours in 1981 and the low was 28.30 in 1967 (Exhibit A-38). In 1982 the rate dropped to 48.4 and has remained around that level since.

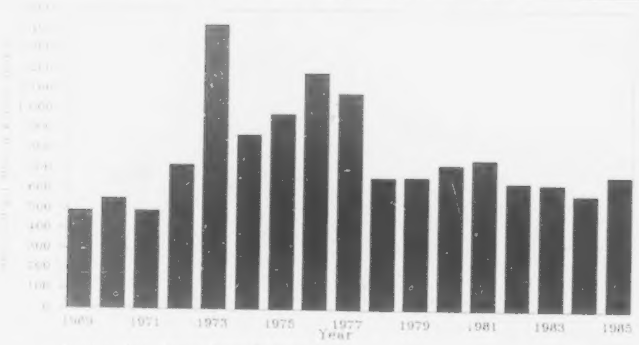
Severity rates exhibit a different pattern. The lowest severity rate for the period is 491 days lost per million worker-hours and the highest rate is a dramatic 1,428 (Exhibit A-39). The period from 1973 to 1977 exhibited an average rate of 1,000, whereas the average for the rest of the period was around 600. The most recent surveys have revealed a severity rate in the high 600s.

Investment Efficiency

Total public spending for wastewater treatment grew rapidly between 1970 and 1981, in direct response to EPA's greatly expanded grants program initiated in 1972 (Exhibit A-40). After peaking at about $12 billion a year between 1979 and 1981, total spending dropped off to about $11 billion a year.

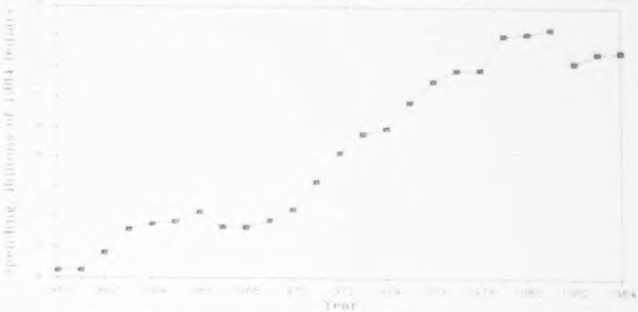
These general shifts, however, mask two underlying trends. First, while total capital spending has dropped off considerably since its peak of nearly $8 billion in 1977, operating expenditures show no sign of levelling off (Exhibit A-41). From a low of $1 billion a year in 1960, local outlays for O&M increased steadily by about 8 percent a year to $6 billion by 1984.

EXHIBIT A-39
INJURY SEVERITY RATE
FOR SEWER SYSTEM MAINTENANCE WORKERS



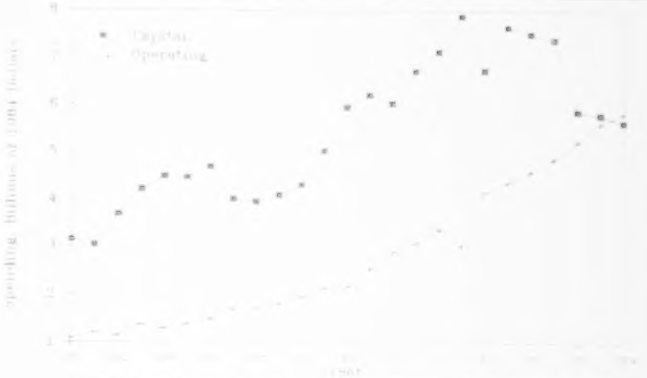
SOURCE: Water Pollution Control Federation

EXHIBIT A-40
PUBLIC SPENDING FOR WASTEWATER TREATMENT



SOURCE: Apogee Research Inc. from published and unpublished U.S. Bureau of the Census data

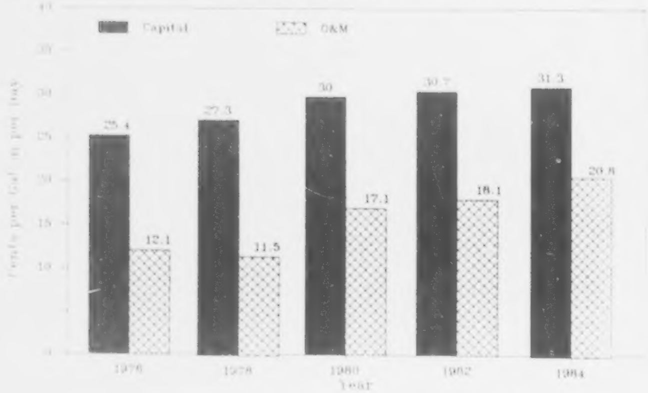
EXHIBIT A-41
COMPARISON OF CAPITAL AND OPERATING EXPENSES FOR WASTEWATER TREATMENT



SOURCE: Apogee Research Inc. from published and unpublished U.S. Bureau of the Census data

EXHIBIT A-42

CAPITAL, OPERATING AND MAINTENANCE EXPENDITURES FOR WASTEWATER TREATMENT



SOURCE: Apogee Research Inc. from the U.S. Environmental Protection Agency, Biennial Needs Survey, various years.

One measure of cost-effectiveness in wastewater treatment is the level of output achieved per dollar invested in a given project. This is simply the inverse of unit costs of treatment. There are two types of unit cost measurements: capital and O&M.[58] The average national capital cost to treat a gallon of wastewater has increased from about 25 cents per gallon per day in 1976 to 31 cents in 1984 (Exhibit A-42). The rate of increase, however, has slowed considerably since 1980. This slowing suggests that the effect of building larger plants, which should drive unit capital costs down, was not strong enough to counteract two forces that were driving unit capital costs up: the construction of excess capacity and increasingly sophisticated or capital-intensive plants. As available capacity is put into service over the coming years, unit capital costs would be expected to decline.

Unit O&M costs have also increased over this period. The national average cost to operate and maintain treatment facilities increased from 12 cents per gallon per day in 1976 to about 21 cents in 1984. This 75 percent increase could be attributable to operating plants well below capacity or an increase in chemical- and energy-intensive systems.

Operating expenses have also grown on a per-capita basis. In 1960, the local operating cost per person served by central sewer systems was $15.80 a year (1984 dollars). At the beginning of EPA's expanded program in 1972, local operating costs per person served was $17.30 a year. By 1984, local operating costs increased to $37.20 per person.

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[58] Capital unit costs are calculated as the sum of amortized capital payments for facilities currently in service (assuming a 20-year life) divided by the yearly flow of treated wastewater. O&M unit costs are simply annual O&M outlays nationwide divided by total national flow treated.

While construction costs have risen much more slowly than inflation since 1982, operating and maintenance costs have risen about 1 percent to 2 percent a year above inflation. A recent survey of 50 large wastewater systems found that O&M expenses increased by 35 percent between 1983 and 1986.[59] Inflation accounted for only 9 percent of this increase. The remainder may be due to declining operating efficiencies or more energy or chemical-intensive treatment processes.

Growth in aggregate operating expenses has stemmed from growth in the number of treatment plants, miles of sewers in service, and number of households served by these facilities. Growth in per-capita operating expenses is a result of a growing number of smaller systems serving the sewered population and more energy- and chemical-intensive treatment processes coming on-line.

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[59] Association of Metropolitan Sewerage Agencies, "Financial Strategy - 1987" (1987), p. 21.

WATER RESOURCES[60]

The nation's water resources development program is comprised of many diverse elements. These include services that support domestic and foreign waterborne commerce; prevent or contain natural hazards affecting land, property, and lives; enhance crop production; produce electricity; and provide water-related recreation as well as enhancement to fish and wildlife habitat areas. The facilities that provide these services include a vast number of ports, locks, dams, levees, channels, breakwaters, storm sewers, and other drainage facilities.

Because an analysis of all these areas would be unwieldy, only flood control (primarily the Corps of Engineers' program) and navigation (inland waterways and coastal ports) are discussed here. These two areas represent the majority (85 percent) of federal investment in the construction of water resources projects, as measured by recent outlays of the Corps of Engineers (Exhibit A-43). Additional information from the Soil Conservation Service (SCS) flood control program has been included where information is available.

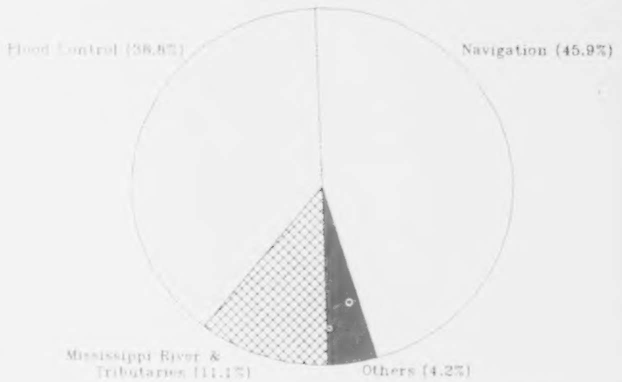
The economic or investment efficiency of *flood control programs* is difficult to measure directly. One indicator, annual flood damages averted relative to annual program capital costs, suggests that the Corps' flood control dams have yielded returns substantially in excess of the costs of building and maintaining them.

The nation's *navigation system* has performed moderately well over the past 25 years. Physical assets of the inland waterways, for example, have grown at an annual rate of 1.8 percent since 1960. Over that same period, ton-miles of cargo handled on the inland waterway system, indicative of product delivery, grew at an annual rate of 4.7 percent and represented 11 percent of all intercity freight traffic.

The cost-effectiveness of federal expenditures on the inland waterways system measured as costs per ton-mile, has dropped slightly from $0.17 in 1977 to $0.16 in 1987. However, this overall average masks large variations between certain segments. The Atlantic Intercoastal Waterway, for example, is one of the costliest segments to operate and maintain at $2.76 per ton-mile over the last ten

EXHIBIT A-43

TOTAL 1986 PROJECT OUTLAYS BY THE ARMY CORPS OF ENGINEERS



SOURCE: From unpublished U.S. Army Corps of Engineers, Office of Chief, Programs Division data

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[60] This section is based on information contained in "A Consolidated Performance Report On The Nation's Public Works," prepared by Apogee Research for the National Council on Public Works Improvement, August 1987, and *The Nation's Public Works: Water Resources*, prepared by Kyle Schilling, et. al., for the National Council on Public Works Improvement, May 1987.

years. Maintaining the Lower Mississippi segments, on the other hand, costs only $0.11 per ton-mile.

FLOOD CONTROL STRUCTURES

Overall the Corps' flood control program performs well. Flood control projects have averted damages substantially in excess of the costs incurred to build and maintain structures. Except for a few major calamities, most flood-related deaths are caused by flash floods on small streams that cannot be protected by structural flood control measures.

State and Local Investment in Flood Control

Many state and local governments make substantial structural and nonstructural investments in flood control and for stormwater management systems. Although important to local flooding and drainage management, these investments are difficult to quantify or evaluate since no centralized source for such data exists. Available information suggests that about $60 billion has been invested in local urban drainage systems—roughly the same amount that has been spent on public wastewater treatment systems.[61]

Federal Investment in Flood Control

Although total Corps outlays for the flood control program fluctuated considerably in the 1960s and 1970s, they have remained relatively stable at around $1.1 billion since 1982 (Exhibit A-44). This total includes spending for construction, operation, and maintenance; emergency flood control; and a special flood control program for the Mississippi River and its tributaries. Construction outlays peaked in the mid-1960s, again in the early 1970s, and have fallen since to about $550 million in 1987 (Exhibit A-45). Operation and maintenance outlays have continued to increase over this period, from about $20 million in 1960 to $200 million in 1987.

SCS expenditures fluctuated between $31 and $217 million between 1960 and 1987, averaging about $82 million (Exhibit A-44).[62]

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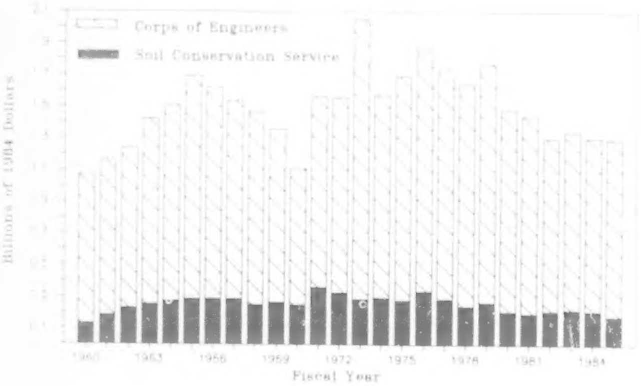
[61] Kyle Schilling, et al., *The Nation's's Public Works: Report on Water Resources*, prepared for the National Council on Public Works Improvement, May 1987, p. 64.

EXHIBIT A-44

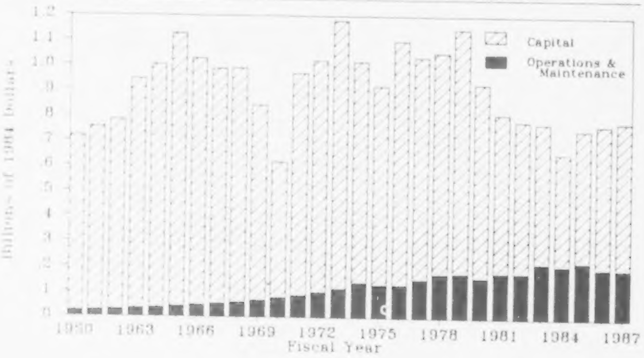
OUTLAYS FOR CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE FLOOD CONTROL PROGRAMS



SOURCE: U.S. Office of Management and Budget, Budget Appendix of the United States (various years) and U.S. Department of Agriculture, Soil Conservation Service, Appropriations History, June 1987.

EXHIBIT A-45

CONSTRUCTION AND OPERATIONS & MAINTENANCE COSTS FOR THE ARMY CORPS' FLOOD CONTROL PROGRAM



SOURCE: Office of Management and Budget, Budget Appendix of the United States, various years

Physical Assets

Flood control assets are measured by the number of flood control facilities. The Corps of Engineers operates over 300 reservoirs that have been built primarily for flood control. In addition, other federal agencies including the Soil Conservation Service, Tennessee Valley Authority, and the Bureau of Reclamation build and operate a less extensive array of flood control structures.

While the Corps maintains data on the number of flood control reservoirs, no such physical asset data are collected for the other types of flood control structures—levees, dikes, and so on.

Data on the Corps of Engineers' flood control reservoirs indicate that their number has doubled since 1960, but the rate of increase has declined (Exhibits A-46 and A-47). These data suggest three distinctive periods in the addition of new flood control reservoirs: the 1960s, when facilities grew by an average of 6 percent a year; the 1970s, when facilities were added more slowly—about 2 percent a year; and the 1980s, when net additions slowed even further—less than 1 percent a year.

Data on the Soil Conservation Service's Small Watershed Program shows a peak of facilities construction in the 1960s that has since slowed dramatically. (Exhibit A-48). Total facilities have increased significantly since 1960 but have slowed in the 1980s (Exhibit A-49).

Service Delivery

Flooding is the most destructive and costly natural disaster in the United States. It accounts for 85 percent of all disasters declared by the President, affecting every region of the country. Approximately 160 million acres or 7 percent of the total U.S. land area is classified as flood plains. Urban expansion into floodplains has been increasing at an estimated rate of 1.5 percent to 2.5 percent a year and as a result, average annual flood damages, adjusted for inflation, have been increasing at about 4 percent annually.

Two indicators of service delivery at the national level (for which data are available) include the volume of flood storage and the population protected by flood control works.

Flood Storage

Cumulative flood control storage grew steadily in the 1960s and 1970s and has

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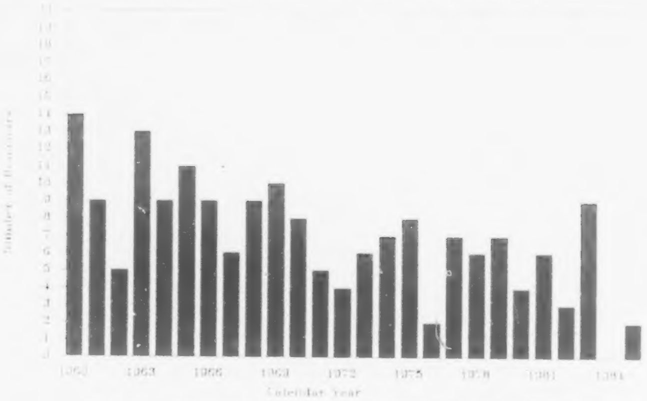
U.S. Department of Agriculture, Soil Conservation Service, unpublished data.

EXHIBIT A-46

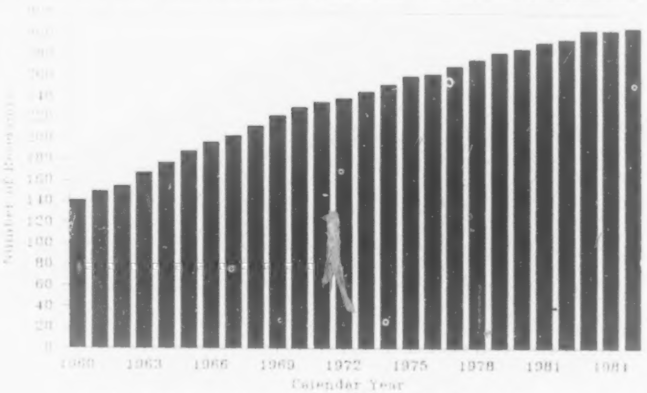
NUMBER OF FLOOD CONTROL RESERVOIRS PUT IN SERVICE BY THE ARMY CORPS OF ENGINEERS



SOURCE: U.S. Army Corps of Engineers, "Annual Report of the Chief of Engineers for Civil Works," various years.

EXHIBIT A-47

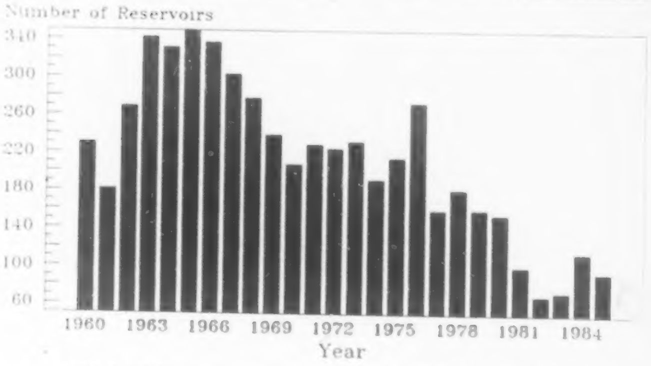
NUMBER OF CORPS FLOOD CONTROL RESERVOIRS IN SERVICE



SOURCE: U.S. Army Corps of Engineers, "Annual Report of the Chief of Engineers for Civil Works," various years.

EXHIBIT A-48

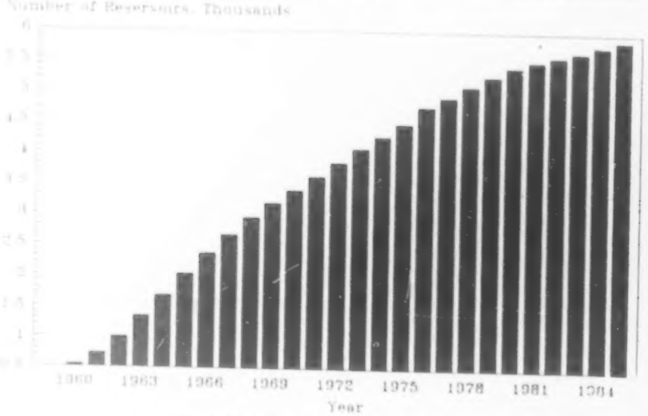
NUMBER OF FLOOD CONTROL RESERVOIRS PUT IN SERVICE BY THE SOIL CONSERVATION SERVICE



SOURCE: U.S. Department of Agriculture, Soil Conservation Service, Unpublished data.

EXHIBIT A-49

NUMBER OF SCS FLOOD CONTROL RESERVOIRS IN SERVICE



SOURCE: U.S. Department of Agriculture, Soil Conservation Service, Unpublished data.

leveled since (Exhibit A-50). It is interesting to note that compared to the 4 percent annual growth in flood storage characteristic of the 1960s and 1970s, the rate of growth in the nation's capacity to store flood waters in major reservoirs has slowed considerably during the 1980s.

Oklahoma, Texas, and parts of Louisiana, Colorado, and New Mexico (the Southwestern Division of the Corps) account for over 50 million acre-feet of flood storage or 31 percent of all such space in Corps reservoirs nationwide. Both the Missouri River and Ohio River Divisions are also responsible for managing significant portions (20 and 14 percent, respectively) of all Corps storage space for flood waters. Flood control facilities built and maintained by the Corps in the Lower Mississippi Valley contain storage space for approximately 16 million acre-feet of water.

Population of Protected Communities

The number of communities protected by Corps' flood control dams has increased in rough proportion to the number of dams placed in service (Exhibit A-51). It is difficult, however, to calculate the exact number of people protected. In 1960, communities whose population totaled about 45 million benefitted by the flood protection of Corps' dams. By 1981, many more communities received some flood protection. In fact, the total population of all flood-protected communities reached 120 million.

Although these are the best estimates available, the figures overstate the actual population protected due to two factors. First, the data represent the population of the nearest downstream community to a reservoir. Only some of these residents will be located in the flood plain. Second, because of this definition, two reservoirs in the same river system could have the same downstream community. In such cases, aggregating the populations of protected communities would result in double counting.

Quality of Service

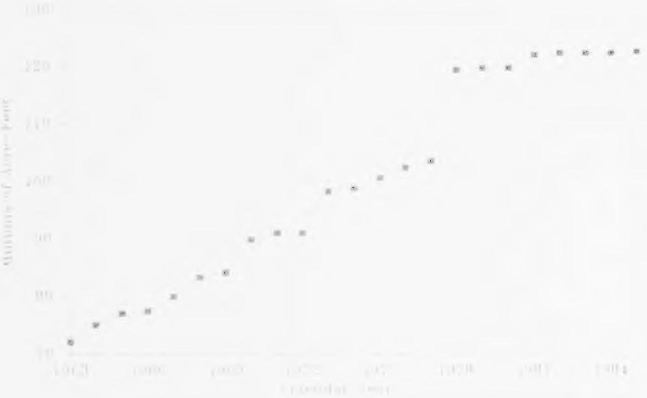
The quality of service in the provision of flood control can be measured several ways including flood damages averted, deaths due to floods (in lieu of deaths averted), and the relative safety of dams.

Flood Damages Averted

Between 1960 and 1985, the Corps of Engineers' projects have prevented an estimated $244 billion dollars (1984 dollars) in potential damages. As a measure,

EXHIBIT A-50

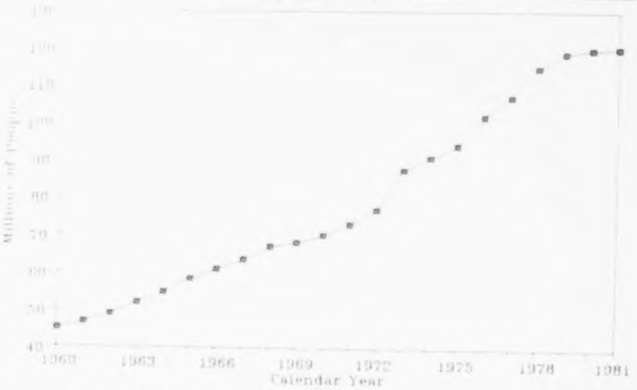
CUMULATIVE STORAGE IN ARMY CORPS OF ENGINEER FLOOD CONTROL RESERVOIRS



Source: U.S. Army Corps of Engineers, [illegible]

EXHIBIT A-51

POPULATION OF COMMUNITIES PROTECTED
BY CORPS' FLOOD CONTROL DAMS



NOTE In many instances only a portion of a community's population actually receives flood control protection from these dams.

SOURCE Federal Emergency Management Agency, National Dam inventory.

flood damages averted is very sporadic. The peak in 1973, for example, corresponds to the aftermath of Hurricane Agnes, which alone caused over $4 billion in damages.

As estimated by the National Oceanic and Atmospheric Administration and predecessor agencies, annual flood damages averaged some $300 million (1985 dollars) a year in the beginning of this century increasing, in the 1970s and 1980s, to about $3 billion.

An associated measure of the effectiveness of flood control programs is the ratio of damages averted to total damages that would have occurred if there were no flood control program.[63] In the majority of years, the Corps' flood control program has prevented a large proportion of the total damages possible (Exhibit A-52). In fact, on average, Corps' dams have prevented an estimated 78 percent of potential damages. In only 2 years, 1972 and 1976, was the total value of actual damages greater than the damages prevented. This is due to excessive rainfall in regions that had little flood protection.

Flood-Related Deaths

The number of flood-related deaths provides another rough indication of the quality of the nation's flood control system. Presumably, if flood control structures and nonstructural methods are performing adequately, and the nation continues to add such controls on a regular basis, rainfall-adjusted deaths should decline over time. Since 1960 there have been 3,515 deaths due to floods (Exhibit A-53). Over 550 deaths resulted from Hurricane Agnes and other extreme events in 1972. There is no way to know the real number of deaths avoided because of flood control structures.

Flood Control Dam Safety

The majority of dams that provide substantial flood control storage are in good condition. In fact, the Corps has never had a major dam fail. The National

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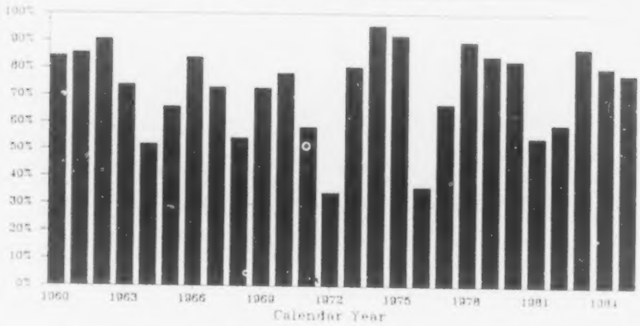
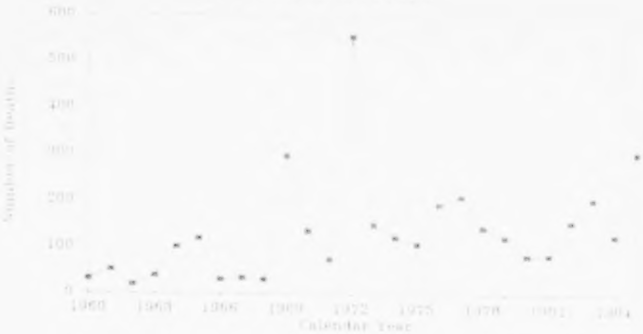
[63] One problem with this calculation is that it assumes that floodplains would have been equally developed in the absence of flood protection. While this is not necessarily the case, there is no way to control for induced floodplain growth.

EXHIBIT A-52
ANNUAL DAMAGES PREVENTED AS A PERCENT OF TOTAL POSSIBLE DAMAGES



SOURCE: U.S. Army Corps of Engineers, "Annual Report of the Chief of Engineers for Civil Works," various years.

EXHIBIT A-53
DEATHS DUE TO FLOODS



SOURCE: Kyle Schilling, et al., "The Nation's Public Works: Report on Water Resources," prepared for the National Council on Public Works Improvement, May 1987.

Dam Safety Inventory shows that while many of the 300 Corps flood control reservoirs are over 50 years old, their physical state is sound overall. It also points out that because of their age, physical condition will become increasing important in the future.

Although most of the 11,000 nonfederal flood control dams are much smaller than their federal counterparts, they are in worse overall condition. The owners of these dams—localities and private interests—do not possess the resources to maintain them. As a result, they have deteriorated at a relatively rapid rate. In fact 33 percent of all nonfederal dams inspected under the national nonfederal dam program were found to be unsafe. Most of these deficiencies were due to inadequate spillways.

Attempting to judge the physical condition of channels, floodwalls, or levees is more difficult. Channels are not considered structures and their performance is primarily based on the frequency of rainfall rather than the lack of maintenance and repair. National data do not exist on the condition and safety of levees or flood walls. Nonetheless, these structures can pose a significant safety hazard similar to dams in the event of failure.

Investment Efficiency

One way to view efficiency is the ratio of the annual flood damages averted (the benefits) to the amortized capital expenditures on flood control, aggregated over an historic period equivalent to the average life of a flood control facility. In essence, this would measure the delivery of flood control benefits nationwide by the total capital stock of flood control structures available to deliver these services. Unfortunately, because the useful life of major flood control dams ranges from 50 to 100 years, it was not possible to calculate these ratios within the scope of this study.

Instead, it is possible to calculate annual flood damages averted relative to annual program capital costs. If this ratio remains above two, it is reasonable to conclude that annual benefits exceed the aggregated past costs of providing flood control structures. If it is between 1.5 and 2, the assurance of net benefits is inconclusive. Below 1.5, it would be safe to assume that costs exceed benefits for that year. These ratios, calculated annually over the period 1960-1985, are presented in Exhibit A-54. The data indicate that flood control expenditures have provided significant benefits above their costs.

Conclusions

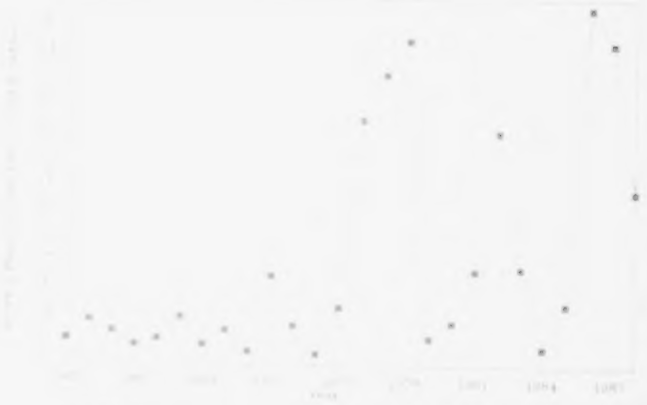
Increasing flood damages coupled with development concentration in flood plains indicates a continuing need for investment in structural flood control, along with nonstructural and compensation strategies. Flood control needs which can be identified are now more localized, with greater identifiable local benefits consistent with local/state construction or larger nonfederal shares for projects with federal participation. Consistent with an increased nonfederal role, is the need to reevaluate planning approaches, performance levels, and design standards.

THE NAVIGATION SYSTEM

The goals of the nation's inland and coastal navigation program are to facilitate the movement of foreign and

EXHIBIT A-54

RATIO OF AVERTED DAMAGES TO CAPITAL OUTLAYS
FOR CORPS' FLOOD CONTROL PROJECTS



SOURCE: Apogee Research, Inc. from published and unpublished U.S. Army Corps of Engineers data domestic waterborne commerce in service to U.S. and international markets as well as to maintain a viable navigation system for national defense purposes. The system is justified for national defense purposes since over three-fourths of the strategically sensitive manganese and ferrous alloys move on the inland waterways to steel plants and because a strong navy depends on properly maintained ports for dockage.

Performance of the nation's navigation system is based on the ability of private and public investments to meet the country's demands for waterborne transport of goods in bulk and containers. Considering this goal, the nation's system appears to have performed well over the past 25 years. In 1985, the inland waterways carried over 500 million tons of commerce, a 100 percent increase from 1960. This represented 15 percent of all intercity freight traffic. In 1985, U.S. ports handled over 1.18 billion tons of commerce with an estimated value of $307 billion. Current concerns include the effects of aging locks on inland waterway performance, congestion at selected facilities, and the need for deeper coastal ports to handle larger ships.

INLAND WATERWAYS

Physical Assets

Both public and private entities have invested extensively to build the physical assets of the nation's inland waterways system. Federal assets consist primarily of locks and dams. Nonfederal assets include terminals and landside facilities located at 128 river ports, as well the fleet of barges and tow boats that use the system.

The federal government has invested in 21,000 miles of navigable waterways and 260 locks and dams, 225 of which are used primarily for commercial purposes. The majority of locks were built prior to 1960 (Exhibit A-55). Over the past three decades, the overall number of lock chambers has grown at an annual rate of 2.8 percent. The replacement cost for all federal investments has been estimated at $40 billion which includes all federal channels, locks, and dams.

Investment in river terminal facilities is extensive. Assets consist of terminals and other landside facilities such as cranes and warehouses. The replacement value of these facilities has been estimated at over $115 billion.[64] Over 1,500 terminal and riverports are scattered along the waterways with the highest concentrations found along the Mississippi River and its tributaries (Exhibit A-56). Illinois has largest number of terminals (252), followed by Pennsylvania (172), and Kentucky (152).

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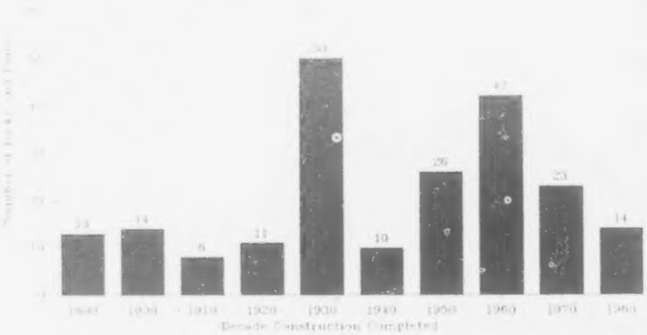
[64] U.S. Department of Transportation, Maritime Administration, *A Report to the Congress on the Status of the Public Ports of the United States* (September 1986).

EXHIBIT A-55

AGE OF FEDERAL COMMERCIALLY OPERATED LOCKS AND DAMS



SOURCE: U.S. Army Corps of Engineers, Institute of Water Resources, Navigation Division, "Status of Inland Waterways, 1987," July 1987.

EXHIBIT A-56
NUMBER OF TERMINALS AND INLAND PORTS BY STATE

STATE	NUMBER OF TERMINALS	NUMBER OF RIVER PORTS
Illinois	252	18
Pennsylvania	172	7
Kentucky	152	8
W. Virginia	151	7
Louisiana	132	10
Ohio	123	11
Tennessee	120	6
Missouri	118	2
Iowa	80	6
Minnesota	60	5
Indiana	50	6
Mississippi	49	5
Arkansas	33	4
Wisconsin	18	4
Nebraska	15	2
Alabama	14	14
Oklahoma	14	3
Kansas	10	2
TOTAL	1,633	128

Source: Maritime Administration, *Report to the Congress on the Status of Public Ports of the United States*, (September 1986).

Private investment in floating stock (vessels) is a vital component of the waterway system. The U.S tow boat fleet (tows) has increased by 22 percent from 4,054 vessels in 1960 to 4,954 in 1985.[65] The number of tows has increased the fastest in the Mississippi River and tributaries, a trend that corresponds to the concentration of the barge industry.

The number of barges (tanker and dry cargo) has more than doubled from 16,454 in 1960 to 33,539 in 1985.[66] The difference in growth rates between tows and barges suggests that either the number of barges per tow is increasing or the surplus of barges is growing. Other indicators seem to point to a combination of both.

Service Delivery

Since the main purpose of the inland waterways system is to facilitate the transportation of waterborne commerce, the best indicator of service is the amount of traffic as measured in tons, or ton-miles of freight. The total tonnage carried on the inland waterways system has almost doubled from approximately 290 million tons in 1960 to 534 million tons in 1985 (Exhibit A-57). The dip in traffic from 1980 to 1983 can be attributed to a number of factors including economic recession, a basic restructuring of the U.S. manufacturing economy, and reduced coal and grain exports.[67]

Ton-miles measure traffic but take into account length of haul as well as total tons. Ton-miles have tripled over the last 25 years, from 80 billion in 1960 to 240 billion in 1984 (Exhibit A-58). The smoother increase in ton-miles as compared to total tonnage may reflect a trend toward longer hauls of bulk commodities. The growth in ton-miles between 1960 and 1972 exceeded the growth in national economic output as measured in real GNP. Since 1972, however, ton-miles have grown at about the same pace as GNP.

Most of the traffic carried on the inland waterways is divided among five commodities (Exhibit A-59). In 1985, energy products such as coal, oil, and petroleum products made up over 50 percent of all traffic, followed by nonmetallic minerals and products (14.2 percent), agricultural products (13.2 percent), and chemicals (7.6 percent).

A final measure of service delivery, the percentage of intercity tons carried on the

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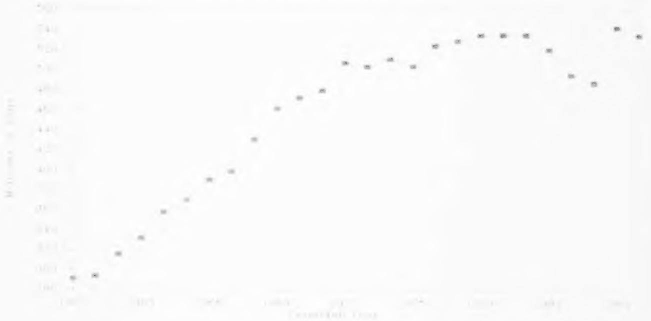
[65] Corps of Engineers, *Summary of United States Flag Passenger and Cargo Vessels*, Transportation Series, U.S. Army Corps of Engineers Waterborne Commerce Statistics Center.

[66] Ibid.

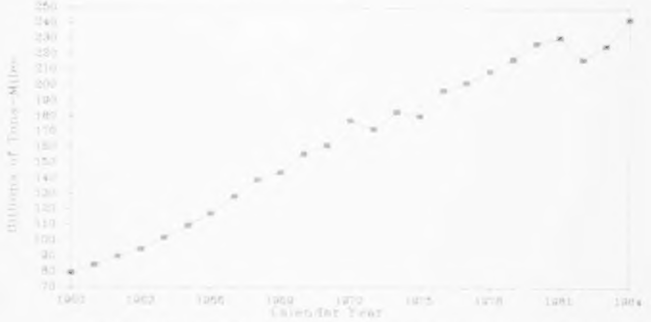
[67] The Inland Waterway fuel tax, created in 1978, may also have diverted some traffic off the waterways to competing modes. It would be very difficult, however, to separate the effects of this tax from the broader macroeconomic forces of the period.

EXHIBIT A-57
TONS OF TOTAL FREIGHT CARRIED ON UNITED STATES SHALLOW DRAFT WATERWAYS



SOURCE: U.S. Army Corps of Engineers, "Waterborne Commerce of the United States: Part 5—National Summaries," various years.

EXHIBIT A-58
TON-MILES OF INTERNATIONAL TRAFFIC CARRIED ON UNITED STATES SHALLOW DRAFT WATERWAYS



SOURCE: U.S. Army Corps of Engineers, "Waterborne Commerce of the United States: Part 5—National Summaries," various years.

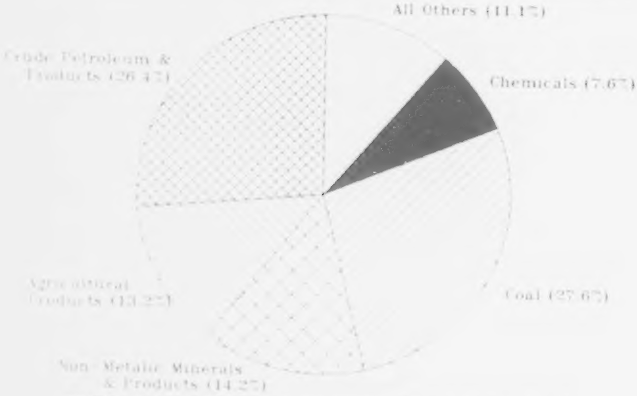
inland waterways has increased only slightly from about 8 percent in 1960 to 9 percent in 1984 (Exhibit A-60). The percentage of intercity waterborne ton-miles, on the other hand, has shown a greater increase over this period. These trends indicate that society has relied on the inland waterways to carry a relatively stable portion of long-haul commodities.

Quality of Service

The quality of inland waterway transportation can be measured by congestion

EXHIBIT A-59

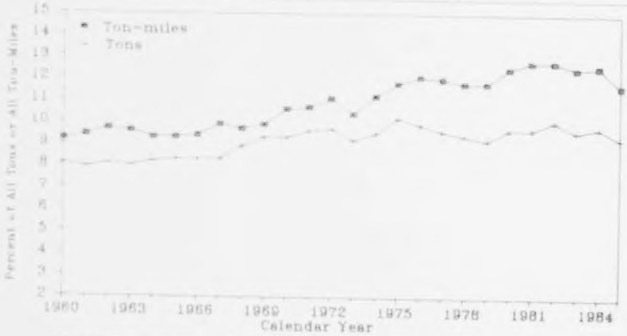
COMMODITIES TRANSPORTED ON THE NATION'S INLAND DRAFT WATERWAYS IN 1985



SOURCE: U.S. Army Corps of Engineers, Institute for Water Resources, Navigation Division.

EXHIBIT A-60

INTERCITY TONS AND TON-MILES OF FREIGHT CARRIED ON UNITED STATES INLAND WATERWAYS



SOURCE: Transportation Policy Associates, "Transportation in America."

and processing time at locks (delays), lock utilization rates and the amount of time that locks are inoperable due to system failures (downtime).

Delays

The average delay per tow—a measure of congestion or system breakdown—serves as a good overall indicator of system performance. This measure is defined as the total time spent waiting in queues, plus the total time spent waiting during lock stalls each year, divided by the total number of commercial vessels moving through the lock. In 1986, the majority of delays occurred on the Ohio and Upper Mississippi Rivers, where half the locks have average delays greater than 23 minutes. Average delays among all locks range from none to over 15 hours.

Delays depend greatly on the traffic and condition of the lock. The Ohio and Upper Mississippi River Segments not only have the oldest and smallest locks on the system, they carry the most traffic. Hence, delays are high. The Atlantic Intracoastal Waterway and the Mobile River and Tributaries, on the other hand, had short average delays mostly because traffic was quite light on these segments relative to others. The heavily traveled Lower Mississippi segments had relatively short delays despite high traffic. This was mostly due to the availability of modern high-capacity facilities.

Processing time is defined as the time, measured in minutes from a tow's arrival at a lock, for chambering, exiting, and turnback. Although the approach, chambering, exit, and turnback times vary, the most important reason for longer processing time is the number of double lockages, typical of small locks in larger systems.

The median processing time for all locks in 1986 was 73 minutes. Average processing time ranged from 15 minutes to 959 minutes. Locks with low average times are found primarily on the Atlantic Intracoastal Waterway and the Mobile River and Tributaries (Exhibit A-61).

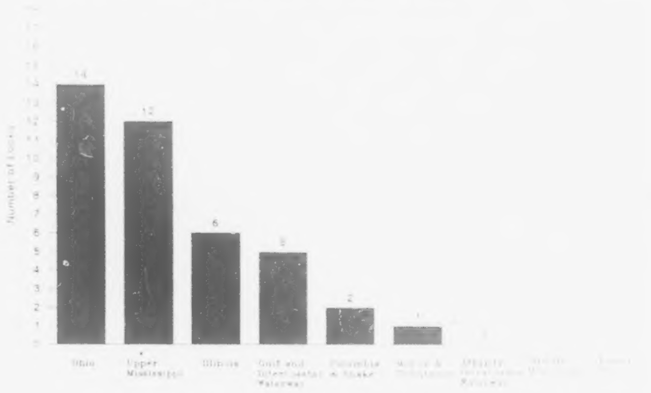
Utilization

In general, the locks with the highest utilization rates experience the most delays and significant downtime. Conversely, a lack of traffic usually results in less downtime. The lock utilization rate (expressed as a percentage) is simply the time a lock is in actual use, divided by the amount of time the lock is available in a given year.

Half of all locks in 1986 were used less than 39 percent of the time they were operational. The data indicate that a great number of locks were used only 20 percent of the time. Only a few were in use nearly all the time. Utilization exceeded 50 percent at 36 locks. Locks with highest utilization rates in 1986 were the Inner Harbor (97 percent) and Algiers (90 percent) both on the Gulf Intracoastal Waterway, and Winfield (79 percent) on the Kanawha River. The reason these locks have high utilization rates, although they handle relatively low volumes of traffic, is probably due to a large amount of recreational use.

EXHIBIT A-61

INLAND WATERWAY SYSTEM LOCKS WITH TWO HOURS OR MORE OF PROCESSING TIME IN 1986



SOURCE: U.S. Army Corps of Engineers, [illegible] Navigation Division, July 1987.

Downtime

Another indicator of the quality of inland navigation services is the failure rate of locks, or simply, downtime. Downtime is defined as the number of hours per year a lock is unable to operate or is stalled. This measure indicates how structurally sound the lock is.

In 1986, half of all commercially operated locks had less than 53 hours of downtime with a range from zero to about 2,400 hours (nearly a third of the year). The four locks that had the highest stall times were Montgomery on the Ohio River (2,379 hours), Lock and Dam 16 on the Upper Mississippi River (765 hours, due in part to two floods and ice problems), London on the Kanawha River (1,421 hours), and Inner Harbor on Gulf Intracoastal Waterway (495 hours).

Investment Efficiency

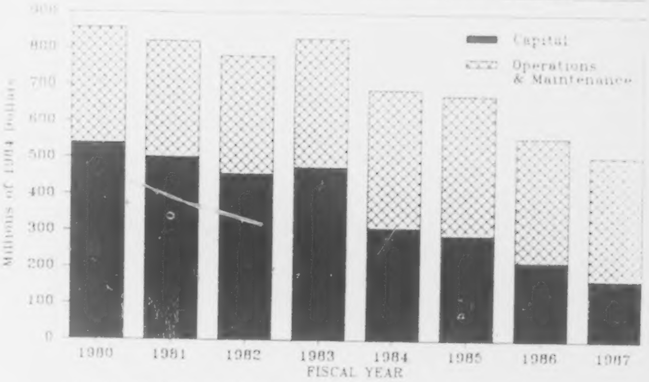
The efficiency of the inland waterways system can be measured in terms of federal expenditures to maintain the system and private expenditures to use and access the system on a per-unit basis. Recent federal spending has focused on the major rehabilitation and operation and maintenance of an already established system. Corps appropriations for construction have declined over the last decade, while O&M has remained constant in real terms. Federal capital appropriations have fallen from $520 million in 1980 to about $150 million in 1987 (Exhibit A-62). O&M appropriations have held steady at about $300 million a year.

Federal spending to maintain the inland waterways system is typically measured in terms of expenditures per ton-mile, where expenditures include only operation and maintenance and do not reflect depreciation of capital stocks. Since 1977, unit costs for the entire system have been generally constant from $0.17 per ton-mile in 1977 to an estimated $0.16 per ton-mile in 1987.

However, this overall average masks large variations in cost per ton-mile between certain segments. The Atlantic Intracoastal Waterway, for example, is one of the most expensive segments to maintain, averaging $2.76 per ton-mile over the last 10 years. The Lower Mississippi segments, on the other hand, cost $0.11 per ton-mile.

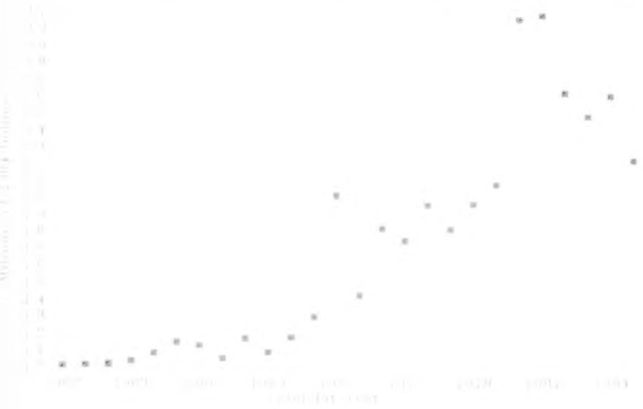
Private cost-effectiveness is much harder to measure. One indicator—the nation's inland waterways' freight bill—measures the price consumers pay for waterborne transportation of goods and services. The nation's inland waterway freight bill increased from about $1 million in 1960 to $3 million in 1981. It has since declined to $2.3 million (Exhibit A-63). The peaks in the early 1970s and the early 1980s probably reflect the corresponding increase in oil prices.

EXHIBIT A-62
INLAND WATERWAY APPROPRIATIONS TO THE ARMY CORPS OF ENGINEERS



SOURCE: U.S. Army Corps of Engineers, Institute for Water Resources, Navigation Division

EXHIBIT A-63
THE NATION'S INLAND FREIGHT BILL



SOURCE: Transportation Policy Associates, Transportation in America

PORTS AND HARBORS

Most of the Corps' maintenance dredging budget is directed to deep-draft ports as opposed to inland waterways. This budget bottomed out in 1969 at $300 million and has since increased to about $500 billion in 1984. Maintenance dredging has increased steadily from less than $200 million in 1963 to over $450 million in 1984 (Exhibit A-64).

Physical Assets

There are 188 deep draft ports along the coastal United States and the Great Lakes. Investment in coastal ports is in deepening channels and maintenance dredging. Nonfederal investments are in landside facilities and floating stock (vessels). However, locks are often constructed to allow ease of entrance into harbors, especially on the Great Lakes. For example, the 16 locks and their 23 chambers constructed on the Great Lakes are maintained by the U.S. and Canadian governments.

Landside facilities are the responsibility of the states, local governments, and the private sector. Investment in such facilities includes terminals, piers, warehouses, cranes, other loading/unloading equipment, and highway and railroad connections. A total of 1,841 terminals supported by over 3,000 berths are found at the U.S. ports. Five new ports have been added since 1982, but six have ceased operation. Landside facilities have grown considerably since 1982, especially at North Atlantic and Gulf Ports. The decrease in the number of berths in the Great Lakes is probably associated with the decline in the regional steel industry. General cargo make up the largest portion of terminals (40 percent) followed by dry bulk (22 percent), passenger (2 percent) and other types (16 percent).[68]

Service Delivery

The most common measures of use of the nation's ports are cargo tons and the value of imports and exports. Since 1960, the tonnage handled by U.S. ports has nearly doubled (Exhibit A-65). Tonnage peaked in 1978 and dropped off through 1983, due largely to world-wide economic recession. In 1985, U.S. ports handled approximately 20 percent of world seaborne trade, based on tonnage of commodities transported. The long-term increase in tonnage has occurred at the coastal ports rather than on the Great Lakes. In fact, tonnage has actually decreased on the

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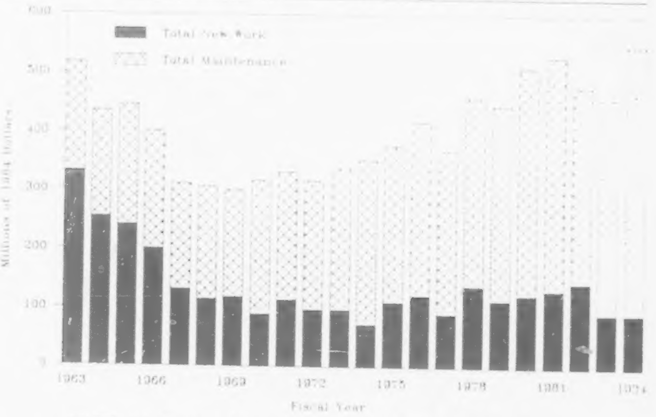
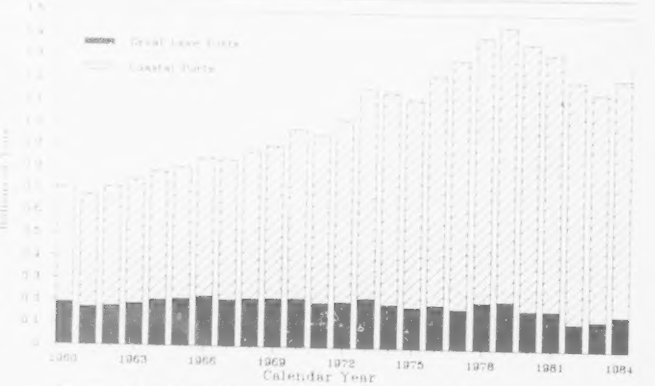
[68] U.S. Department of Transportation, Maritime Administration, *Report to the Congress on the Status of Public Ports in the United States*, op cit.

EXHIBIT A-64
DREDGING EXPENDITURES BY ARMY CORPS OF ENGINEERS



SOURCE: U.S. Army Corps of Engineers, Office of Chief Engineer, Programs Office.

EXHIBIT A-65
TONS OF CARGO HANDLED BY UNITED STATES COASTAL AND GREAT LAKE PORTS



SOURCE: U.S. Army Corps of Engineers, "Waterborne Commerce of the United States, Part V—National Summaries," various years.

Great Lakes. Nationwide, the growth in tons between 1960 and 1969 did not keep up with national economic output. However, between 1970 and 1980, tons grew at a faster rate than GNP, but steadily declined thereafter.

A second measure of the level of service provided by the nation's ports is the total value of commodities imported and exported. Trends in value are not in themselves reflections of port performance. They have more to do with exchange rates and trade imbalances, which are beyond the control of port operators. However, the value of commodities is a good indication of the importance of ports to the national economy.[69] The inflation-adjusted value of imports and exports, for example, nearly quadrupled from about $80 billion in 1960 to about $310 billion in 1985, relatively small proportion of which can be attributed to increased oil prices. The majority of the increase in the value of dry trade is attributable to rising imports of automobiles and consumer electronics.

Quality of Service

The quality of service provided by coastal ports is based on the cargo they are able to attract. Two possible indicators of such services include maintenance of necessary channel depths (to avoid grounding) and loading/off loading services. Unfortunately, very little data are available to characterize the ports in terms of either quality measure.

Maintaining channels at their authorized depths is crucial. The weakest part of a vessel, especially a tanker, is its bottom hull area. Fortunately grounding accidents rarely occur within dredged harbor areas of major ports, suggesting that the Corps of Engineers either adequately maintains channel depths where necessary or alerts shipping interests where channels are unsafe.

Smaller ports, however, are more difficult to maintain because they often experience extraordinary littoral (sediment) drift. Many are located along the mid-Atlantic coast. One good example is the Oregon Inlet in the Outer Banks region of North Carolina. Because Corps dredging simply cannot keep up with the drifting sands that often block the channel, the inlet is frequently closed, and fisherman cannot land their fish at the harbor at Wanchese, North Carolina.

Terminal operations have a much bigger impact on the quality of services. These factors consist of terminal productivity, capacity, labor, and intermodal access to rail and highway transportation facilities.

To measure such factors, information would be needed on equipment failure rates, ship waiting times, crane lifts per hour, cargo damages and theft as well as output per man-hour. Since ports are largely independent authorities, these data are not centralized and system-wide analysis is nearly impossible. Also, because ports are so competitive they are unwilling to publish data, even though many shipping lines often request such information.

Although such quality of service data are not centrally collected, similar measures are often kept by the ports themselves. A recent National Academy of Sciences study investigated performance at selected ports and reached several conclusions on terminal productivity:[70]

- U.S. marine terminals are generally employing state-of-the-art technology and engineering design.
- The best U.S. terminals are not as productive as the most productive foreign terminals. The main reasons for this seem to be that European and Asian ports have better stacking facilities as well as better labor-management relations.

Investment Efficiency of Ports

Measuring the cost effectiveness of the Corps' dredging program is difficult because natural ports require minimal dredging while man-made ports may require constant maintenance. Generally, deeper ports may have larger dredging requirements, but hydrodynamic and geographic factors greatly influence dredging requirements.

To account for these differences, cost-effectiveness can be measured as unit cost to dredge a cubic yard of sediment.[71] The total cost (in 1984 dollars) to dredge 1 yard of material nearly doubled, from less than 80 cents a yard in 1960 to

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[69] This does not include commodities shipped coastwise between U.S. ports. Although large amounts of bulk commodities, especially coal, are shipped coastwise, this number is relatively low compared to the total value of imports and exports.

[70] National Academy of Sciences, Committee on Productivity of Marine Terminals, *Improving Productivity in U.S. Marine Container Terminal* (1986).

[71] Cost-effectiveness cannot be measured as dredging cost per ton of cargo. This indicator is far more sensitive to import/export demand and the efficiency of landside facilities than it is to the effectiveness of dredging. Except for congestion, which has not been a consistent problem historically, the same expenditure to dredge a channel will result in vastly different levels of imports and exports, depending primarily on shipping activity.

$1.40 a yard in 1986. Since the late 1970s, the Corps has increasingly contracted out dredging to private industry. Currently, the Corps contracts out all deepening work and more than 80 percent of all maintenance dredging.

Hence, there are several explanations for the increasing trend in dredging cost per yard. First, the transition to private dredging could have incurred extra cost due to scaleup and allowances for profit. Second, the amount of dredged material has declined, demonstrating the effects of economies of scale (public or private). Unit costs simply increased as volume of dredged material decreased. Third, some of the increase in cost per yard could be attributable to rising real energy rates in the mid to late 1970s. Fourth, environmental legislation has created a need for diking and the transport of dredging material over longer distances. Finally, the unit cost of dredging deeper ports is expected to increase. The effects of dredging innovations on efficiency (if any) are unclear.

SOLID WASTE FACILITIES

Solid waste management in the United States can generally be broken down into two categories of involvement: (1) the collection and transportation of municipal solid waste; and (2) the disposal of municipal solid waste. Because this country is confronted with a crisis regarding the disposal of solid waste, the primary attention here is on the problem of where to put it down once it has been picked up.

The ultimate responsibility for all facets of solid waste management—collection, transportation, and disposal—most often falls upon local governments—municipal, county, or regional. Municipal solid waste collection is generally performed by one of the following:

- The public works department of the local government;
- A private hauler under contract with the local government;
- A private hauler operating in a franchise area contracting directly with the residential or commercial generators of the waste; or
- Two or more competing private haulers operating in the same unfranchised area(s).

Physical Facilities

Currently, over 16,000 municipal solid waste landfills operate in the United States. EPA reported the following characteristics of municipal solid waste landfills:[72]

- Publicly owned—77 percent;
- Less than 100 acres in size—93 percent;
- Accept less than 500 tons of waste per day—95 percent;
- Designed without
  - — liners—85 percent,
  - — leachate collection systems—95 percent,
  - — gas collection systems—83 percent,
  - — run on/run off controls—54 percent;
- Accept liquid and special wastes—52 percent;
- Operating without environmental monitoring systems for
  - — groundwater—75 percent,
  - — surface water—88 percent,
  - — air-96 percent,
  - — explosive gases—95 percent.

While resource recovery facilities are beginning to help with the disposal problem, the number of operating facilities is still relatively limited—approximately 70 units were either in shake-down or operation as of 1985 (Exhibit A-66).[73] The total quantity of waste processed by resource recovery facilities in 1984 has been estimated to be approximately 6,500,000 tons, which represents anywhere from 4 to 5 percent of the waste being generated.[74]

Physical Assets

No national data track historical changes in numbers of units, capacity, or population served for the different types of solid waste management facilities. In the area of resource recovery facilities, however, annual data were obtained for total number, capacity, and cost of facilities, beginning in the early 1960s.[75] Data were also available on the net depreciated capital stock of solid waste facilities from 1973 to 1984.[76] These series tell the same story—resource recovery facilities are growing rapidly. From one facility in 1965, the number of units is expected to grow to nearly 300 by 1991. Prior to 1985, only 58 such facilities were in operation (Exhibit A-66).

Net Capital Stocks

The net depreciated capital stock of solid waste facilities consistently increased between 1973 and 1984 (Exhibit A-67). The average growth rate for this

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[72] "Subtitle D Report," Waste Age, January 1987, p. 113.

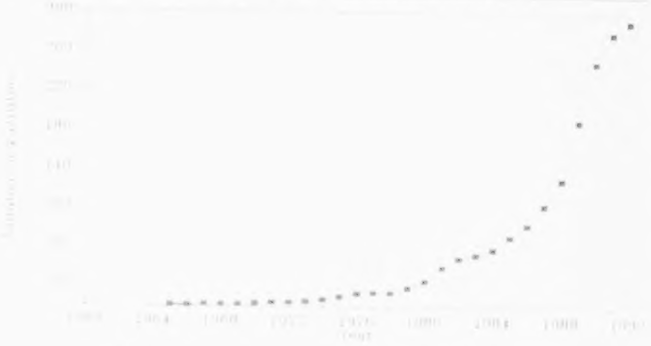
[73] "Resource Recovery," *American City and County*, October 1986, p. 86.

[74] Franklin Associates, Ltd., *Characteristics of Municipal Solid Waste in the United States, 1960 to 2000*, prepared for the U.S. Environmental protection Agency, Office of Solid Waste, July 1986, pp. 1-6.

[75] Kidder, Peabody & Co. Inc., "Computerized Printout of Resource Recovery Projects in the U.S." (July 1987).

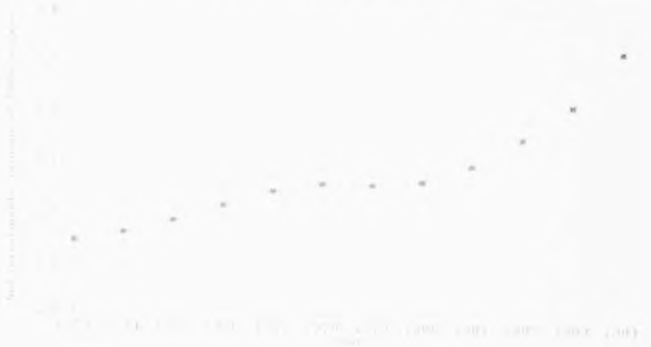
[76] U.S. Department of Commerce, Office of Business Analysis, in *Effects of Structural Changes in the U.S. Economy on the Use of Public Works Services*, a report to The National Council on Public Works Improvement, (1987).

EXHIBIT A-66
NUMBER OF RESOURCE RECOVERY FACILITIES



SOURCE: Apogee Research, Inc. from unpublished data compiled by Kidder, Peabody and Co.

EXHIBIT A-67
NET DEPRECIATED CAPITAL STOCK OF SOLID WASTE DISPOSAL FACILITIES



SOURCE: U.S. Department of Commerce, [illegible] period, however, was only 1.6 percent. This low growth rate is due to the relatively short useful lives of landfills and the precipitous drop in net additions of landfills since the passage of the Resource Conservation and Recovery Act (RCRA) in 1976. Resource recovery facilities are growing rapidly, but spending for these facilities does not yet appear in the capital stock totals. Nonetheless, the overall positive trend suggests that new additions to solid waste capital stock have outpaced the depreciation of existing capital stock.

Service Delivery

The extent of the waste disposal problem in this country cannot be overemphasized. Approximately 450,000 tons of waste are generated every day, 95 percent of which is disposed in rapidly filling landfills.

In 1985, total public spending on the construction and operation of solid waste facilities amounted to $5.1 billion;[77] about $700 million of that total was capital investment. While total public spending has increased 168 percent since 1960, the U.S. population increased only 32 percent. As a result, per capita public spending on solid waste facilities increased 80 percent—from $11.93 in 1960 to $21.44 in 1985.

During the same period, the average rate of waste disposal per person increased 35 percent—from 2.3 pounds per person per day in 1960 to about 3.1 pounds per person per day in 1985. Thus, per capita public spending on solid waste facilities increased more than twice as fast as the generation of waste over the last 25 years.

In 1981, resource recovery facilities had the capacity to handle only about 20,000 tons per day, representing approximately 5 percent of national solid waste disposal. By 1992, however, the total capacity of these units is expected to be close to 240,000 tons per day (Exhibit A-68). Given these trends, it is not hard to see why capital spending for these facilities trickled at less than $1 billion through 1982, and is expected to surge to a projected level of $17 billion by 1991 (Exhibit A-69).

Quality of Service

Because of growing public environmental concern, it is increasingly difficult to site either a landfill or a resource recovery facility. Potential environmental concerns associated with a landfill include contamination of groundwater supplies by leachate from the landfill, contamination of surface water supplies by runoff from the landfill, migration of landfill gases, wind blown litter and debris, and the existence of vermin. Environmental concerns with resource recovery facilities currently revolve around questions related to air emissions, such as dioxins and acid gases, and the existence of toxic elements in the residue ash.

The quality of service category includes two interrelated but distinct components: quality of service to the direct users, and quality of service to the "rest of the world," as measured by system externalities. Unfortunately, no national source of historical information exists for either quality of service to users or the external effects of solid waste services. If available, some of the applicable indicators would include waste spills, noise, congestion, and, perhaps most important, environmental contamination from waste disposal activities. One indicator of groundwater contamination is the proportion of municipal solid waste landfills on the Superfund National Priorities List (NPL). At present, 108 of the approximately 900 sites on the NPL are former municipal solid waste landfills. Many of these facilities once accepted or inadvertently received hazardous waste.

EPA reported that approximately 25,000 municipal solid waste landfill inspections were performed in 1984, with over 8,000 reported violations, the majority of which (59 percent) were reported to be operational in nature, such as inadequate daily cover or blowing litter.[78] Other reported violations include groundwater monitoring program deficiencies (10 percent), air contamination (10 percent), surface water contamination (8 percent), groundwater contamination (7 percent), and methane control deficiencies (2 percent).[79]

It is clear, however, that increasing costs of disposing of society's garbage are driven, in large part, by increasingly

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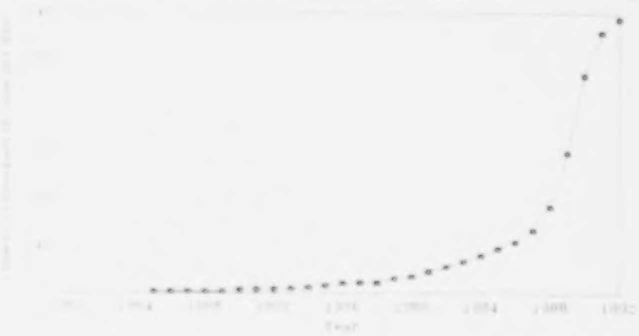
[77] [illegible] public and private spending [illegible] waste exceeded $15 billion in 1985 [illegible] public and private spending.

[78] [illegible]

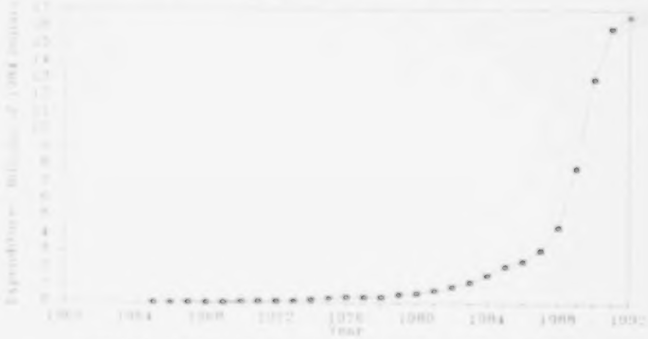
[79] [illegible]

EXHIBIT A-68
RESOURCE RECOVERY FACILITY CAPACITY



SOURCE: Apogee Research Inc. from unpublished data supplied by Kidder, Peabody and Co.

EXHIBIT A-69
COMMULATIVE PRIVATE CAPITAL EXPENDITURES
ON RESOURCE RECOVERY FACILITIES



SOURCE: Apogee Research Inc. from unpublished data supplied by Kidder, Peabody and Co.

stringent environmental regulations. In October, 1976, the federal government established the Resource Conservation and Recovery Act (RCRA) to deal with the management and disposal of hazardous and municipal wastes and the procurement of materials made from recovered wastes.

Since its original enactment, RCRA has been periodically modified to reflect changes in landfill technology and public awareness of environmental problems associated with solid waste landfills. The RCRA criteria are standards for landfills that apply to issues such as water quality, gas migration, sanitation, operation, and cover soil requirements.

Major amendments to RCRA were adopted by Congress with the Used Oil Recycling Act of 1980 (UORA) and the Hazardous and Solid Waste Amendments of 1984 (HSWA). The 1984 Amendments require the U.S. Environmental Protection Agency (EPA) to revise the Subtitle D criteria by March 31, 1988. As a minimum, the revised criteria must cover three regulatory categories pertaining to landfills: groundwater monitoring, location criteria, and corrective action. Because of uncertainty about the requirements of these performance standards, few new landfills are opening while existing ones are closing at an alarming rate. For example, Massachusetts had about 500 active landfills in 1970. That number declined to 400 in 1980 and 189 in 1987; it is projected to fall to 90 by 1990—a reduction of nearly 80 percent in 10 years.

Investment Efficiency

As a result of environmental concerns, waste disposal sites are becoming increasingly costly and difficult to locate. In 1974, 12.3 percent of waste management costs went to disposal as compared to collection; in 1980, 20.2 percent of waste management costs went to disposal. This near doubling of the percentage contribution of disposal to waste management costs occured because disposal fees nearly tripled over this six-year period while collection costs increased by only about one-half. These large increases in disposal costs are primarily due to regulation of the waste management industry, while the other increases are due largely to more general economic forces.

In the 1950s and 1960s, the standard solid waste management practice was land disposal of waste. It was the least expensive technology available, and few questioned possible environmental contamination. In the 1970s, as the nation's environmental consciousness was raised, land disposal of waste came under fire. With an increase in land disposal costs caused by environmental regulations and increasing land values in the 1970s and 1980s, there was a greater demand for alternative disposal options. This fueled an increase in the number of resource recovery facilities built. In addition, the 1981 tax provisions of rapid depreciation and investment tax credits stimulated private interest in financing these public facilities. This, along with the introduction of proven and efficient resource recovery technologies (largely from overseas), now provides the impetus for rapidly increasing growth in this disposal method.

Although overall quality of municipal refuse collection is perceived to be good for both public and private service delivery, comparability is not as evident in other areas. On average, municipal refuse collection is 28 to 42 percent more costly than refuse collection by a private contractor.[80] This is due primarily to lower worker absentee rates (often encouraged by the use of incentive systems), less vehicle down time, and higher labor productivity in private systems.

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[80] Ecodata, Inc. "Comparative Service" (1984).

HAZARDOUS WASTE[81]

Each year U.S. industries generate more than two tons of hazardous waste for every man, woman, and child in the nation. Federal and state laws regulate how these contaminants must be treated and disposed. But even when managed properly, these wastes pose significant risks to the environment and public health. The legacy of mishandling past industrial residues persists in the form of some 900 uncontrolled waste disposal sites. These sites are eligible for federal cleanup to arrest leaking toxic contaminants to groundwater, rivers, and streams. Conservative estimates of the total number of waste sites that will eventually require cleanup run into the thousands, with costs up to $100 billion.

Physical Facilities

Only limited information exists on the current capacity of U.S. hazardous waste management facilities or the private sector's ability to add new capacity, given future demand. The Environmental Protection Agency (EPA) has recently conducted surveys, however, counting the number of treatment, storage, and disposal (TSD) facilities. These data provide some insight into the capacity issue.

Capacity figures are difficult to determine from these numbers alone because:

- The vast majority of TSD facilities—90 to 95 percent—are onsite and managed by individual private firms, and data, though available in various forms, are inconsistent and difficult to compile.
- It is hard to determine if planned capacity will actually be put into place, since plans are so dependent on the permitting process, siting procedures, and government regulation stimulating sufficient demand.
- Once facilities have been identified, there are many ways to interpret how much additional waste they could handle.

Exhibit A-70 lists the total number of TSD facilities and the commercial offsite component for each type. These data were collected in 1986 and represent facility profiles as of 1985.[82] Since then, several facilities have gone out of business and others have come on-line. The following sections present a brief "snap-shot" profile of facilities.

Thermal Destruction

Thermal destruction technologies include all types of incineration—liquid injection, rotary kilns, fluidized-bed plus cement kilns, and industrial boilers. The method used depends on the waste phase—liquid, sludge, or solid—and the heating value of the particular waste stream.

According to the National Screening Survey, 189 incineration facilities treat two million metric tons (MMT) of waste annually. Only 18 incinerators, however, are commercially operated. The commercial facilities handle about a quarter of the total waste incinerated.

Treatment

Hazardous waste treatment technologies include a wide variety of chemical, biological, and physical processes. These onsite industrial or offsite commercial technologies either remove hazardous constituents from wastewaters or convert hazardous waste into less hazardous or nonhazardous forms. According to the National Screening Survey, only 13 percent or 187 of the 1407 treatment facilities in the United States offer commercial services.

Impoundments

Surface impoundments are simply excavated basins in the ground used to store, treat, or dispose of a variety of hazardous wastes. Surface impoundments are widely used for settling solids from wastewater, dewatering sludges, neutralizing and separating waste constituents, and biodegrading organic matter in waste waters.

Estimates of the total waste handled in surface impoundments vary substantially.

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[81] This section is drawn from Apogee Research, Inc. *The Nation's Public Works: Report on Hazardous Waste Management*. National Council on Public Works Improvement, Washington DC, 1987.

[82] U.S. Environmental Protection Agency, *National Screening Survey, December 1986*.

Exhibit A-70.

NUMBER OF TSD FACILITIES BY TYPE OF PROCESS IN 1985

Type of Process	All Facilities	Commercial[a] Facilities
THERMAL DESTRUCTION	464	38
Incinerators	189	18
Industrial Boilers	275	20
TREATMENT	1,407	187
Bio. Wastewater Treatment	150	16
Other Wastewater Treatment	948	86
Steam Stripping	45	11
Solidification	211	84
Treatment Impoundments	149	15
Other	556	106
STORAGE	2,585	400
Impoundment	222	178
Waste Pile	55	12
Tanks	2,585	400
LAND DISPOSAL	433	58
Underground Injection	79	11
Impoundment	49	10
Landfill	101	33
Waste Pile	56	12
Land Treatment	71	5
RECYCLING	846	220
Solvent Recovery	447	131
Reuse as Fuel	279	47
Other	327	104

[a] Some of these facilities offered only limited commercial services at otherwise on-site locations.

SOURCE: U.S. Environmental Protection Agency, *National Screening Survey*, December 1986.

The EPA estimates that each year 55 percent of all waste—145 million tons—is managed in some form of impoundment.[83] The Congressional Budget Office (CBO) estimates that annually only 19 percent of the total amount of waste is treated, stored, or disposed of in impoundments.

The Office of Technology Assessment (OTA) found that in 1983 there were approximately 1,100 surface impoundments used to treat, store, or dispose of hazardous wastes.[84] By 1985, the National Screening Survey determined that there were only 420 impoundments, 203 of which were commercial offsite facilities.

Land Disposal

Land disposal includes the following types of facilities: landfills, surface impoundments, waste piles, land treatment, and underground injection. Landfills, which dispose of hazardous waste by burial in excavated cells or trenches, account for one-quarter of all land disposal units, but over half of all commercial land-based facilities.

The number of land-based disposal units has declined significantly in recent years. In mid-1983, over 1,600 land-disposal facilities were in operation. To remain operational beyond 1988, all these facilities must apply for a Part B permit under The Conservation and Recovery Act (RCRA) and meet stringent technological and financial standards. By September 1985, about 400 land-based facilities were actively pursuing operating permits. But a year later, only 19 had received permits and 42 others had proceeded to the draft permit stage.

By September 1986, 22 million metric tons of hazardous waste had been disposed of in 433 land-based facilities. Of these facilities, 49 are commercially operated and account for roughly 4 million metric tons of waste per year.[85] At the rate of waste generation, these commercial facilities should last for 12 years.

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[83] U.S. House of Representatives Hearing, *Potential Hazardous Waste Volume and Capacity Problems*, (September 24, 1987).

[84] OTA, *Technologies and Management Strategies for Hazardous Waste Control*, (March 1983).

[85] U.S. House of Representatives Hearing, *Potential Hazardous Waste Volume and Capacity Problems*, (September 24,1986).

Deep-Well Injection

According to the CBO, the EPA, and the OTA, deep-well injection is the most common method of disposal.[86] The practice of deep-well injection involves pumping hazardous waste several thousand feet below the surface into saline, permeable injection zones. Deep-well injection is regulated by the EPA through the Underground Injection Control Program (UIC) of the 1974 Safe Drinking Water Act.

An EPA survey found 252 Class I wells located in 15 states. Of these, 181 were actually used in 1983. These 181 wells were injected with an estimated 43.5 million metric tons of hazardous waste in 1983. Of the 15 states with wells, Texas had the most with 69, followed by Louisiana with 60, Ohio with 14, and Michigan with 11.[87]

The National Screening Survey found 79 facilities that operated deep-well injection sites. Of these, 11 were commercially operated. Most of these 79 facilities operated more than one well and injected about 35 million metric tons of waste per year into 180 wells.

Service Delivery

Hazardous waste management facilities are intended to safely treat and dispose of the hazardous residuals of industrial processes. Apogee Research, Inc. estimates that 265 million metric tons (MMT) of these wastes were generated in the United States in 1983 (Exhibit A-71). By 1986, this total is estimated to fall only slightly to 260 MMT. These estimates exclude the hazardous wastewaters generated and regulated under the Clean Water Act, which may amount to 322 MMT.

Waste Generation By Type of Waste[88]

In 1983, nonmetallic inorganic liquids accounted for 31 percent of total generation. Nonmetallic inorganic sludges accounted for another 11 percent. Wastes that are expected to decline by 1986 include those generated by industries with declining industrial production those with a high potential for waste reduction or reuse. Solvents and inorganic liquids will fall the most, averaging 30 percent and 32 percent, respectively. Other wastes are expected to increase as industrial production increases and because the opportunities to reduce waste generation or reuse waste products are few. These wastes include the nonchlorinated organic sludges (up 13 percent), the inorganic sludges without metals or cyanides (up 13 percent), and the explosives (up 24 percent).

Hazardous Waste Generation By Industry

The Chemicals and Allied Products group of manufacturing industries accounted for about 51 percent of all hazardous waste generated in the United States during 1983 (Exhibit A-71). Within this group (Standard Industrial Classification (SIC) codes 2812 through 2899) the Alkalies and Chlorine industry (SIC code 2819) accounted for over 16 percent, the Industrial Organic Chemicals industry (SIC code 2869) for almost 19 percent, and the Agricultural Chemicals Industry (SIC code 2879) for 8 percent.

The two most important factors that affect waste generation over time are changes in industrial activity—output—and explicit efforts to reduce waste generation in response to changes in regulations—increased cost of waste management and disposal and risks of long-term liability under Superfund. The combination of these activities is expected to result in sharp dropoffs in waste generation by 1986 within the following industries: Rubber and Plastic Footwear (SIC code 3021) down 36 percent; Steel Pipe and Tubes (SIC code 3317) down 35 percent; Electrometallurgical Products (SIC code 3313) down 34 percent; and Cellulosic Manmade Fibers (SIC code 2823) and Drum Reconditioners (SIC code 5085), both down 32 percent.

Other industries are expected to increase their waste generation by 1986: Semiconductors and Related Services (SIC code 3674) is expected to double; and three industries within the Non-Electrical Machinery Group should increase by about 20 percent each—Construction Machinery (SIC code 3531), Printing Trades Machinery (SIC code 3555), and Electronic Computing Equipment (SIC code 3573).

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[86] Office of Technology Assessment, *Technologies and Management Strategies for Hazardous Waste Control* (March, 1983).

[87] U.S. Environmental Protection Agency, *Report to Congress on Injection of Hazardous Waste*, EPA 570/9-85-003, May 1985.

[88] Waste categories used in this study group combine some 450 individual waste streams regulated by the EPA into 24 categories based on waste phase and major constituent. All wastes within a category can be treated and disposed in largely the same manner.

Exhibit A-71

ESTIMATED GENERATION OF HAZARDOUS WASTE IN 1983 AND 1986 BY INDUSTRY

(metric tons)

Industry	SIC code	MT/YR 1983	MT/YR 1986	Percent of 1986 Total
Wood Preserving	2491	1,738,605	1,797,645	0.7%
Alkalies & Chlorine	2812	4,871,517	4,264,964	1.6
Industrial Gases	2813	7,615	7,803	0.0
Inorganic Pigments	2816	57,155	55,911	0.0
Industrial Inorganic Chems	2819	36,545,339	41,980,333	16.2
Plastics/Resins	2821	5,045,363	5,078,463	2.0
Synthetic Rubber	2822	204,643	173,120	0.1
Cellulosic Fibers	2823	2,404	1,639	0.0
Non-Cellulosic Fibers	2824	3,389,333	3,488,948	1.3
Medicines & Botanicals	2833	2,481,471	2,286,260	0.9
Paints & Allied Prod	2851	2,079,598	1,812,791	0.7
Gum & Wood Chemicals	2861	390,000	307,005	0.1
Cyclic Crudes	2865	1,733,085	1,955,905	0.8
Indus. Organic Chems	2869	46,491,972	47,994,955	18.5
Agricultural Chems	2879	19,683,199	19,967,439	7.7
Explosives	2892	1,349,055	1,591,261	0.6
Printing Ink	2893	132,101	128,083	0.0
Chemical Preparations	2899	2,693,979	2,067,972	0.8
Petroleum Refining	2911	31,004,557	26,985,803	10.4
Lubricating Oils	2992	350,996	366,864	0.1
Tires & Inner Tubes	3011	430,069	437,144	0.2
Rubber & Plastic Footwear	3021	338	218	0.0
Rubber, Plastic Hose	3041	5,054,683	5,676,198	2.2
Fabricated Rubber Products	3069	383,155	414,021	0.2
Miscel Plastics	3079	8,732,173	9,400,571	3.6
Blast Furnaces	3312	24,744,830	23,644,608	9.1
Electrometallurgical Prod	3313	408	268	0.0
Steel Wire	3315	4,331,027	3,640,993	1.4
Steel Pipe & Tubes	3317	1,977,283	1,285,945	0.5
Gray Iron Foundries	3321	12,044,684	11,434,688	4.4
Steel Foundries	3325	1,163,082	1,108,053	0.4
Primary Zinc	3333	509,894	495,105	0.2
Primary Non-Ferrous	3339	231,464	219,015	0.1
Secondary Non-Ferrous	3341	1,936,520	1,665,211	0.6
Copper Roll & Draw	3351	267,671	250,272	0.1
Aluminum Sheet, Foil	3353	598	500	0.0
Non-Ferrous Rolling	3356	131,913	121,603	0.0
Metal Heat Treating	3398	28,095	26,858	0.0
Primary Metal Prod	3399	281,303	285,685	0.1
Metal Cans	3411	64,711	54,702	0.0
Bolts, Nuts, Washers	3452	1,966,132	1,963,957	0.8
Auto Stamping	3465	2,720,033	2,778,261	1.1
Metal Stamping	3469	113,402	101,905	0.0
Plating/Polishing	3471	19,911,993	14,279,914	5.5
Metal Coating	3479	587,547	537,805	0.2
Construction Machinery	3531	3,268,509	3,943,559	1.5
Machine Tools	3541	37,541	30,499	0.0
Special Dies Tools	3544	72,951	68,305	0.0
Food Products, Mach	3551	18,578	16,255	0.0
Woodwork Mach	3553	2,835	2,717	0.0
Printing Mach	3555	518,332	621,678	0.2
Special Industry Mach	3559	207,484	172,580	0.1
Electronic Computing	3573	616,602	750,858	0.3
Refrigeration Heating	3585	116,486	114,385	0.0
Motors & Generators	3621	9,469	9,496	0.0
Industrial Controls	3622	43,371	39,300	0.0
Carbon & Graphite	3624	602	598	0.0
Electron Tubes	3671	11,739	11,720	0.0
Semiconductors	3674	18,537	37,429	0.0
Electronic Comp	3679	1,490,387	1,255,861	0.5
Storage Batteries	3691	114,975	109,857	0.0
Primary Batteries	3692	239,999	267,396	0.1
Motor Vehicles	3711	259,509	237,738	0.1
Motor Vec Parts	3714	2,529,717	2,660,162	1.0
Aircraft	3721	2,842	2,328	0.0
Aircraft Engines	3724	58,898	44,784	0.0
Aircraft Equipment	3728	126,169	97,877	0.0
Miscell Manufacturing	3900	5,538,697	4,970,686	1.9
Motor Freight	4200	2,160,000	2,021,143	0.8
Drum Reconditioners	5085	44,958	30,619	0.0
TOTAL		265,374,181	259,654,497	100.0%

SOURCE: Apogee Research, Inc.

Investment Efficiency

The private costs of hazardous waste management totalled nearly $2.5 billion in 1984, according to the Bureau of the Census.[89] In constant dollars, this represents a 75 percent increase in the industrial cost of hazardous waste management since 1976, the year that RCRA was passed. For most industries, the cost of hazardous waste management, as reported by the Bureau of the Census, is equivalent to less than one-third of 1 percent of industry-wide sales.

Spending for Cleanup

Over the next five years, the nation is expected to pay at least $8.5 billion to clean up as many Superfund sites as possible.[90] An unknown amount will also be spent by private industry to clean sites that the EPA and the states have identified. Industry will also spend an unknown amount to clean up sites before they attract public scrutiny. The states are responsible for a considerable amount of money that is necessary to match federal Superfund allocations—10 percent if the site was privately owned and 50 percent if it was publicly owned.

Using EPA's average per site cleanup costs of $10 million,[91] if 10,000 sites eventually end up on the NPL, it could cost over $100 billion to clean them up.[92] But this estimate may be low as a recent EPA projection of the cost to clean up a typical NPL site is $30 million to $40 million—following the new cleanup standards initiated in 1986.[93] If long-term groundwater cleanup costs are included, costs may be as high as $300 million to $600 million per site. Clearly, the Superfund capitalized at any reasonable level would be insufficient to even scratch the surface of a program of this magnitude.

Private Sector Costs for Hazardous Waste Control Plant and Equipment

Industrial spending for hazardous waste control plant, equipment, and operations increased from some $800 million in 1976 to $2.4 billion in 1984 (current dollars). Even after adjusting for inflation, 1984 spending increased to about $1.4 billion (in 1976 dollars), or a 75 percent real increase. These spending levels would double, however, if industry were in full compliance with RCRA and the toxic control portions of the Clean Water Act.[94] Nonetheless, these expenditures appear relatively small when measured against Gross Domestic Product (GDP) of nonfarm businesses (.08 percent in 1984), total investment in manufacturing plant and equipment (1.73 percent in 1984), or total manufacturing sales (1.27 percent in 1984) (Exhibit A-72).

Perhaps more important, all these indicators have increased since the mid-1970s. For example, industrial spending for hazardous waste control has increased as a proportion of manufacturing sales from .81 percent in 1976—the year RCRA was first passed—to 1.27 percent in 1984. As a proportion of nonfarm business GDP, hazardous waste control spending has increased from .06 percent in 1976 to .08 percent in 1984. As a proportion of industrywide spending for pollution control (air, water, and hazardous waste), spending for hazardous waste control has more than doubled from 11.2 percent in 1976 to 28.4 percent in 1984.

These figures indicate that industrial concern for environmental regulation is shifting away from water and air programs and toward hazardous waste programs. In so doing, industry is spending ever-increasing amounts to comply with regulations, which in turn, consume increasing proportions of sales dollars, funds allocated to industrywide capital expansion, and total economy-wide output of goods and services.

Costs to Society

No studies have measured the costs to society of national hazardous waste management regulations. However, numerous studies have estimated the aggregate economic costs associated with overall

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[89] These figures include the costs to manufacturing establishments only, but they encompass both solid and hazardous waste management costs. See Bureau of the Census, *Current Industrial Reports: Pollution Abatement Costs and Expenditures.*

[90] This includes expected outlays of the Federal Superfund, but not independent state-financed cleanup. Superfund is capitalized mostly from taxes on the petroleum chemicals industries plus small annual appropriations.

[91] EPA now estimates the average cost per site at $15-20 million. EPA Office of Drinking Water.

[92] OTA, *Superfund Strategies,* (1985).

[93] Gene A. Lucero, Chief of the Office of Waste Programs Enforcement, U.S. Environmental Protection Agency, as cited in Bureau of National Affairs, Inc., *Superfund II: A New Mandate* (February 13, 1987).

[94] See Congressional Budget Office, *Hazardous Waste Management: Recent Changes and Policy Alternatives* (May 1985).

Exhibit A-72

INDUSTRIAL EXPENDITURE FOR HAZARDOUS WASTE CONTROL PLANT AND EQUIPMENT, 1976-1984

Year	Industrial Spending on Hazardous Waste Control Plant, Equip & Operations (billions)	Hazwaste Spending as % of All Pollution Equipment Spending	Hazwaste Spending as % of Gross Domestic Product—Non-Farm	Hazwaste Spending as % of All Plant and Equipment Spending	Hazwaste Spending as % of All Manufacturing Sales
1976	.80	11.2	06	1.37	81
1977	.99	13.5	06	1.47	87
1978	1.20	15.6	06	1.53	95
1979	1.35	15.7	07	1.41	94
1980	1.69	18.4	08	1.50	1.09
1981	1.88	20.3	08	1.49	1.12
1982	1.68	18.7	07	1.39	1.06
1983	2.20	28.1	08	1.89	1.29
1984	2.40	28.4	08	1.73	1.27

SOURCE: Apogee Research Inc. based on Bureau of Economic Analysis for expenditure and Gross Domestic Production data and Bureau of the Census for sales data.

environmental regulation. Most have concluded that aggregate effects on productivity and output are small. There also appears to be a consensus that adverse economic effects that arise within a few years of new regulations often decline over time. One study compared aggregate effects of regulations on GNP and employment in the 1970s and 1980s for four industrialized countries. The study concluded that environmental regulations had not put U.S business sector as a whole at a disadvantage when compared to the business sectors of Japan, Germany, and Canada.[95] This study goes on to point out, however, that some sectors within the U.S. economy probably were placed at a disadvantage compared to their counterparts in other countries.

All environmental regulations—air, water, and hazardous waste—are estimated to reduce national productivity by between .09 percent and .28 percent per year.[96] Moreover, the economy-wide effects of environmental regulations appear to have peaked in 1975 and declined by about half since. Gross domestic product or GDP was estimated to be 1.9 percent lower in 1975 than it would have been without expenditures on pollution control. Prices were .25 percent higher and employment was 3.3 percent lower. By 1982, prices were only .13 percent higher, the loss in GDP fell to .8 percent, and employment losses were cut to 2.3 percent.

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[95] CBO. *Environmental Regulation* (1985).

[96] These figures exclude the effects of private spending to operate and maintain pollution control equipment as well as public spending to administer pollution control programs. While the latter is generally small, private spending for O&M as a rule of thumb is roughly equivalent to capital spending when capital costs of new plant and equipment are recovered over the life of the asset. For a full explanation of what costs are considered, see CBO. *Environmental Regulation* (1985).

APPENDIX II: COMMISSIONED BACKGROUND PAPERS

I. REPORT I: DEFINING THE ISSUES

A. Key Public Works Issues

Apogee Research, Inc., "Infrastructure: Issues, Problems, and General Solutions." July 1986, 46pp.

Cuciti, Peggy. "A Perspective on Public Works: The Nature of the Problem." Center for Public Private Sector Cooperation, Graduate School of Public Affairs, University of Colorado at Denver, July 1986, 30pp.

Garn, Harvey, and Ledebur, Larry C. "Infrastructure in Economic Development." Aslan Associates, July 1986, 28pp.

Royer, Robert and Carr, Cathleen. "Public Improvement: A Concept Paper." Cathleen Carr Associates, July 1986, 25pp.

Wheeler, Porter K. "Conceptualizing Public Works Needs and Issues." July 1986, 46pp.

B. Public Works and the Economy

Eberts, Randall W. "An Assessment of the Linkage Between Public Infrastructure and Economic Development." University of Oregon, July 1986, 40pp.

McGuire, Therese J. "On the Relationship Between Infrastructure Investment and Economic Development." W. Averell Harriman College of Policy Analysis and Public Management, State University of New York at Stony Brook, July 1986, 26pp.

C. Public Works Needs

Apogee Research, Inc. "The Uses and Misuses of Infrastructure Needs Surveys and Inventories." July 1986, 33pp.

Coates, Joseph F. and Jarrett, Jennifer. "The Potential Benefits from Science and Engineering for the American Infrastructure: 1985-2015." J.F. Coates, Inc., July 1986, 115pp.

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Wells, William G., Jr. "Working Paper on Knowledge Sharing." Department of Management Science, George Washington University, July 1986, 79pp.

D. Public Works Financing Trends

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Blumenfeld, Arthur A. "Infrastructure and the Finance Profession." July 1986, 32pp.

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Forbes, Ronald. "Governmental Debt Financing of Public Works." State University of New York at Albany, July 1986, 100pp.

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Ledebur, Larry C., Hamilton, William W., Matz, Deborah; and Anderson, Lori. "Federal and State Roles in Infrastructure." Aslan Associates, July 1986, 93pp.

Petersen, John E., Mallory, James; Pierce, Lawrence; and Weiss, Barbara. "Non-Debt Financing of Public Works Facilities." Government Finance Research Center, July 1986, 107pp.

E. Public Works Decisions

APWA Research Foundation. "Public Works Management Practices." American Public Works Association. July 1986, 75pp.

Colman, William G. "The Public Works Responsibilities of Federal, State, and Local Governments and the Private Sector." July 1986, 92pp.

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Forbes, Ronald and Cassidy, John. "Public Works Budgeting Practices." State University of New York at Albany, July 1986, 46pp.

Frank, Carl J. "An Expanded Role for the Dispute Resolution Profession in Public Works on the Threshold of the Twenty First Century." July 1986, 20pp.

Hanson, Royce. "The Next Generation in the Management of Public Works: Getting Some of it Together." Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, in association with National Academy of Public Administration. July 1986, 87pp.

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Kirby, Ronald F., and Reno, Arlee T. "The Nation's Public Works: A Report on Mass Transit." The Urban Institute, May 1987, 123pp.

Pisarski, Alan E. "The Nation's Public Works: A Report on Highways, Streets, Roads and Bridges." May 1987, 153pp.

Revis, Joseph S., and Tarnoff, Curtis. "The Nation's Public Works: A Report on Intermodal Transportation." May 1987, 150pp.

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Apogee Research, Inc. "The Nation's Public Works: A Report on Wastewater Management." May 1987, 175pp.

Wade Miller Associates, Inc. "The Nation's Public Works: A Report on Water Supply." May 1987, 216pp.

Schilling, Kyle; Copeland, Claudia; Dixon, Joseph; Smythe, James; Vincent, Mary; and Peterson, Jan. "The Nation's Public Works: A Report on Water Resources." May 1987, 183pp.

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Clunie, Jeffrey F. "The Nation's Public Works: A Report Solid Waste." R. W. Beck and Associates, May 1987, 96pp.

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Adams, Charles F., Merget, Astrid E., and Stocker, Frederick D. "Earmarking Revenues for Public Works Projects." School of Public Administration, The Ohio State University, September 1987, 115pp.

Apogee Research, Inc. "Federal Trust Funds: Options to Use the Cash." October 1987, 22pp.

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U.S. Department of Commerce, Office of Economic Affairs. "Effects of Structural Change in the U.S. Economy on the Use of Public Works Services." September 1987, 240pp.

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Apogee Research, Inc., "Maintaining Good Maintenance," technical memorandum prepared for the National Council on Public Works Improvement, September 1987.

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Rivkin, Malcolm D. "Accommodation of Diverse Views in the Public Works Improvement Process." Rivkin Associates, September 1987, 159pp.

Thomassen, Henry. "Indexing the Adequacy of Infrastructure." September 1987, 30pp.

C Other Studies

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Public Works Historical Society. "Public Works and the Shaping of the Nation." American Public Works Association, September 1987, 117pp.

Public Works Historical Society. "Research and Development in Public Works." American Public Works Association, September 1987, 40pp.

APPENDIX III

PUBLIC WORKS IMPROVEMENT ACT OF 1984

Public Law 98-501
98th Congress

An Act

Oct. 19, 1984
[S. 1330]

To establish a National Council on Public Works Improvement to prepare three annual reports on the state of the Nation's infrastructure, to amend the provisions of title 31, United States Code, relating to the President's budget to require it to separately identify and summarize the capital investment expenditures of the United States, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Public Works Improvement Act of 1984

TITLE I—NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

SHORT TITLE

42 USC 3121 note.

SEC. 101. This title may be cited as the "Public Works Improvement Act of 1984".

ESTABLISHMENT

42 USC 3121 note.

SEC. 102. There is established a council to be known as the National Council on Public Works Improvement (hereinafter in this title referred to as the "Council").

DUTIES

Report.
42 USC 3121 note.

SEC. 103. (a)(1) Not later than February 15, 1986, February 15, 1987, and February 15, 1988, the Council shall prepare and submit to the President and the Congress a report on the state of the Nation's infrastructure (hereinafter in this title referred to as the "Infrastructure Report"). Each Infrastructure Report shall include, but not be limited to, an analysis of each of the following:

(A) the age and condition of public works improvements and changes in their condition from preceding years;

(B) the methods used to finance the construction, acquisition, rehabilitation, and maintenance of public works improvements, including but not limited to general obligation and revenue bonds, user fees, excise taxes, direct governmental assistance, and private investment;

(C) any trends in methods used to finance such construction, acquisition, rehabilitation, and maintenance;

(D) the capacity of public works improvements to sustain current and anticipated economic development and to support a sustained and expanding economy;

(E) maintenance needs and projected expenditures for public works improvements.

(2) In addition, each Infrastructure Report—

(A) shall include a discussion of infrastructure program priorities (including alternative methods of meeting national infrastructure needs to effectuate balanced growth and economic development); and

(B) to the extent practicable, shall provide, for other public works facilities owned or operated by the Federal Government, any State or local government, or any public agency or authority organized pursuant to State or local law, an analysis similar to the analysis provided under paragraph (1) for public works improvements.

(b) Not later than September 30, 1985, the Council shall—

(1) analyze criteria and procedures used by Federal agencies, States, and units of local government in inventorying existing and needed public works improvements and assessing the condition of public works improvements and develop and publish uniform criteria and procedures which may be used for conducting such inventories and assessments; and

(2) develop and recommend to the President and the Congress proposed guidelines for the uniform reporting by Federal agencies of construction, acquisition, rehabilitation, and maintenance data with respect to public works improvements.

(c) The Council shall convene its first meeting no earlier than February 15, 1985, and no later than April 15, 1985.

(d) In carrying out its duties under this section, the Council shall use existing data and sampling techniques to the maximum extent feasible. When developing new data under this title, the Council shall make every effort to assure that such data is developed in consultation with the States so that uniform methods, categories, and analyses are used.

(e) Each Infrastructure Report, when submitted to the Congress, shall be referred to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate.

MEMBERSHIP

SEC. 104. (a) The Council shall be composed of five members— 42 USC 3121 note

(1) three of whom shall be appointed by the President;

(2) one of whom shall be appointed by the Speaker of the House of Representatives; and

(3) one of whom shall be appointed by the President pro tempore of the Senate,

from among persons knowledgeable and experienced in one or more of the following: public administration, planning, architecture, civil engineering, and public investment financing.

(b) A vacancy in the Council shall not affect its powers but shall be filled in the manner in which the original appointment was made.

(c) Four members of the Council shall constitute a quorum, but the Council may establish a lesser number as a quorum for the purpose of holding hearings, taking testimony, and receiving evidence.

(d) The Chairman of the Council shall be elected by the members of the Council.

(e) The Council shall meet at the call of the Chairman or a majority of its members.

(f) Members of the Council shall be appointed for the life of the Council.

(g) Members of the Council shall serve without pay, except that they shall receive per diem and travel expenses in accordance with section 5703 of title 5, United States Code.

DIRECTOR AND STAFF

42 USC 3121 note

SEC. 105. (a) The Council shall have a director who shall be appointed by the Council and shall be paid at a rate not to exceed the rate of basic pay payable to level V of the Executive Schedule.

(b) The Council may appoint and fix the pay of such additional personnel as the Council considers appropriate.

5 USC 5101 et seq., 5331.

5 USC 5332 note

(c) The director and staff of the Council may be appointed without regard to the provisions of title 5, United States Code, governing appointments in the competitive service and may be made without regard to the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates. Any Federal employee subject to the civil service laws and regulations who may be employed by the Council shall retain civil service status without interruption or loss of status or privilege. In no event shall any employee of the Council other than the staff director receive as compensation an amount in excess of the maximum rate of basic pay payable for GS-18 of the General Schedule.

POWERS OF THE COUNCIL

42 USC 2121 note

SEC. 106. (a) Upon request of the Council, the head of any Federal agency may detail, on a reimbursable basis, any of the personnel of such agency to the Council to assist the Council in carrying out its duties under this title.

(b) Upon request of the Council, the Secretary of the Army, acting through the Chief of Engineers, shall provide, on a reimbursable basis, such office space, supplies, equipment, and other support services to the Council and its staff as may be necessary for the Council to carry out its duties under this title.

(c) The Council may secure directly from any department or agency of the United States information necessary to enable it to carry out this title. Upon request of the Chairman of the Council, the head of such department or agency shall furnish such information to the Council.

Contracts with U.S.

(d) The Council or any member authorized by the Council may, for the purpose of carrying out this title, hold such hearings, sit and act at such time and places, take such testimony, have such printing and binding done, enter into such contracts and other arrangements (with or without consideration or bond, to such extent or in such amounts as are provided in appropriation Acts, and without regard to section 3709 of the Revised Statutes (41 U.S.C. 5)), make such expenditures, and take such other actions as the Council or such member may deem advisable to carry out this title. Any member of the Council may administer oaths or affirmations to witnesses appearing before the Council or before such member.

ADVISORY GROUP

SEC. 107. (a) There is established an advisory group to provide such assistance and advice as the Council may request. Such group shall be composed of 12 members as follows:

Establishment
42 USC 3121 note

(1) the Secretary of the Army, who shall be the Chairman of such group;

(2) the Secretary of Agriculture;

(3) the Secretary of Housing and Urban Development;

(4) the Secretary of Transportation;

(5) the Administrator of the Environmental Protection Agency;

(6) the Secretary of Commerce;

(7) the Chairman of the National Governors Association;

(8) the President of the National Conference of State Legislatures;

(9) the President of the National Association of Counties;

(10) the President of the National Association of Regional Councils;

(11) the President of the National League of Cities; and

(12) the President of the United States Conference of Mayors.

(b) The members of the advisory group shall serve without pay.

(c) The advisory group shall cease to exist on April 15, 1988.

Termination

CONGRESSIONAL BUDGET OFFICE REVIEW

SEC. 108. Not later than 90 days after the date on which each Infrastructure Report is submitted to the Congress by the Council, the Congressional Budget Office shall review such report and shall submit a report on the results of such review to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate.

Report
42 USC 3121 note

TERMINATION

SEC. 109. The Council shall cease to exist on April 15, 1988.

42 USC 3121 note

FUNDING

SEC. 110. (a) From funds otherwise appropriated to the Secretary of the Army for purposes of civil works, the Secretary shall transfer to the Council in the fiscal year ending September 30, 1985, such amounts as the Council may request but not to exceed $3,200,000.

42 USC 3121 note

(b) There is authorized to be appropriated to the Council to carry out the provisions of this title $3,500,000 per fiscal year for each of the fiscal years ending September 30, 1986, and September 30, 1987, and $2,000,000 for the fiscal year ending September 30, 1988.

Appropriation authorization

DEFINITIONS

SEC. 111. For purposes of this title, the term—

42 USC 3121 note

(1) "acquisition" includes the addition of land, sites, equipment, structures, facilities, or rolling stock by purchase, lease-purchase, trade, or donation;

(2) "construction" includes the design, planning, and erection of new structures and facilities, the expansion of existing structures and facilities, the reconstruction of a project at an existing

site or adjacent to an existing site, and the installation of initial and replacement equipment for such structures and facilities;

(3) "public works improvements" means the following publicly owned civilian facilities: highways; streets; bridges; mass transportation facilities and equipment; resource recovery facilities; airports; airway facilities; water supply and distribution systems; wastewater collection, treatment, and related facilities; dams; federally owned buildings; docks and ports; waterways; and such other public facilities as the Council determines are critical for national economic development;

(4) "maintenance" means regularly scheduled activities, including routine repairs, intended to keep a facility operating efficiently; and

(5) "rehabilitation" includes the alteration of or correction of deficiencies in an existing structure or facility so as to extend the useful life or improve the effectiveness of the structure or facility, the modernization or replacement of equipment at an existing structure or facility, and the modernization of, or replacement of parts for, rolling stock.

Federal Capital Investment Program Information Act of 1984.

TITLE II—FEDERAL CAPITAL INVESTMENT PROGRAM

SHORT TITLE

31 USC 1105 note.

SEC. 201. This title may be cited as the "Federal Capital Investment Program Information Act of 1984".

PURPOSES

31 USC 1105 note.

SEC. 202. The purposes of this title are—

(1) to provide budget projections for major Federal capital investment programs;

(2) to provide a summary of the most recent needs assessment analyses for these programs;

(3) to provide information on the sensitivity of the needs estimates to major policy issues and technical and economic variables;

(4) to assist the planning capabilities of State and local governments on the assessment of major capital investment programs; and

(5) to improve legislative oversight over Federal capital investment programs.

FEDERAL CAPITAL INVESTMENT PROGRAM REPORT

SEC. 203. Section 1105 of title 31, United States Code, is amended by adding at the end thereof the following new subsection:

"(e)(1) The President shall submit with materials related to each budget transmitted under subsection (a) on or after January 1, 1985, an analysis for the ensuing fiscal year that shall identify requested appropriations or new obligational authority and outlays for each major program that may be classified as a public civilian capital investment program and for each major program that may be classified as a military capital investment program, and shall contain summaries of the total amount of such appropriations or new obligational authority and outlays for public civilian capital investment programs and summaries of the total amount of such appropriations or new obligational authority and outlays for military capital investment programs. In addition, the analysis under this paragraph shall contain—

"(A) an estimate of the current service levels of public civilian capital investment and of military capital investment and alternative high and low levels of such investments over a period of ten years in current dollars and over a period of five years in constant dollars;

"(B) the most recent assessment analysis and summary, in a standard format, of public civilian capital investment needs in each major program area over a period of ten years;

"(C) an identification and analysis of the principal policy issues that affect estimated public civilian capital investment needs for each major program; and

"(D) an identification and analysis of factors that affect estimated public civilian capital investment needs for each major program, including but not limited to the following factors:

"(i) economic assumptions;

"(ii) engineering standards;

"(iii) estimates of spending for operation and maintenance;

"(iv) estimates of expenditures for similar investments by State and local governments; and

"(v) estimates of demand for public services derived from such capital investments and estimates of the service capacity of such investments.

To the extent that any analysis required by this paragraph relates to any program for which Federal financial assistance is distributed under a formula prescribed by law, such analysis shall be organized by State and within each State by major metropolitan area if data are available.

"(2) For purposes of this subsection, any appropriation, new obligational authority, or outlay shall be classified as a public civilian capital investment to the extent that such appropriation, authority, or outlay will be used for the construction, acquisition, or rehabilitation of any physical asset that is capable of being used to produce services or other benefits for a number of years and is not classified as a military capital investment under paragraph (3). Such assets shall include (but not be limited to)—

"(A) roadways or bridges,
"(B) airports or airway facilities,
"(C) mass transportation systems,
"(D) wastewater treatment or related facilities,
"(E) water resources projects,
"(F) hospitals,
"(G) resource recovery facilities,
"(H) public buildings,
"(I) space or communications facilities,
"(J) railroads, and
"(K) federally assisted housing.

"(3) For purposes of this subsection, any appropriation, new obligational authority, or outlay shall be classified as a military capital investment to the extent that such appropriation, authority, or outlay will be used for the construction, acquisition, or rehabilitation of any physical asset that is capable of being used to produce services or other benefits for purposes of national defense and security for a number of years. Such assets shall include military bases, posts, installations, and facilities.

Defense and national security.

"(4) Criteria and guidelines for use in the identification of public civilian and military capital investments, for distinguishing between public civilian and military capital investments, and for distinguishing between major and nonmajor capital investment programs shall be issued by the Director of the Office of Management and Budget after consultation with the Comptroller General and the Congressional Budget Office. The analysis submitted under this subsection shall be accompanied by an explanation of such criteria and guidelines.

"(5) For purposes of this subsection—

"(A) the term 'construction' includes the design, planning, and erection of new structures and facilities, the expansion of existing structures and facilities, the reconstruction of a project at an existing site or adjacent to an existing site, and the installation of initial and replacement equipment for such structures and facilities;

"(B) the term 'acquisition' includes the addition of land, sites, equipment, structures, facilities, or rolling stock by purchase, lease-purchase, trade, or donation; and

"(C) the term 'rehabilitation' includes the alteration of or correction of deficiencies in an existing structure or facility so as to extend the useful life or improve the effectiveness of the structure or facility, the modernization or replacement of equipment at an existing structure or facility, and the modernization of, or replacement of parts for, rolling stock.".

Approved October 19, 1984.

LEGISLATIVE HISTORY—S. 1330 (H.R. 1244):

HOUSE REPORTS: No. 98-153 accompanying H.R. 1244, Pt. 1 (Comm. on Public Works and Transportation) and Pt. 2 (Comm. on Government Operations), and No. 98-1134 (Comm. of Conference).
SENATE REPORT No. 98-141 (Comm. on Environment and Public Works).
CONGRESSIONAL RECORD, Vol. 130 (1984):
Feb. 9, considered and passed Senate.
May 15, H.R. 1244 considered and passed House; S. 1330, amended, passed in lieu.
Oct. 4, House agreed to conference report.
Oct. 5, Senate agreed to conference report.

○

APPENDIX IV

Joseph M. Giglio, Chairman

Senior managing director of public finance for the investment banking firm of Bear, Stearns & Co., Inc. Born in Bayonne, New Jersey, he previously served as a cabinet officer under Governor Hugh Carey of the State of New York (1977). He was chairman of the U.S. Senate Budget Committee's Private Sector Advisory Panel on Infrastructure Financing (1985-1987). He is a graduate of Rutgers University (1967), and holds master's degrees in public administration from New York University (1972) and in business from Columbia University (1977). Mr. Giglio was appointed to the Council by the president pro tempore of the U.S. Senate.

Peter C. Goldmark, Jr.

Former executive director of the Port Authority of New York and New Jersey (1977-1985), currently group vice president, Eastern Newspapers for the Times Mirror Company. Born in New York City, he served as director of the budget for the state of New York (1975-1977) and secretary of Human Services for the Commonwealth of Massachusetts (1971-1975). He is a graduate of Harvard College (1962). Mr. Goldmark was appointed to the Council by the Speaker of the U.S. House of Representatives.

Freeman Holmer

Former vice chancellor for administration of the Oregon State System of Higher Education (1969-1979), currently president of the City Council of Eugene, Oregon. Born in St. Paul, Minnesota, he previously served as director of Environmental Protection for the state of Wisconsin (1966-1968) and director of finance and Administration for the state of Oregon (1959-1966). He is a graduate of Concordia College (1938) and holds a master's degree from the University of Oregon (1946). He was professor of political science at Willamette University (1949-1959) and at New York University (1946-1949). Mr. Holmer was appointed to the Council by President Reagan.

Lowell B. Jackson

Registered professional engineer, currently a private consultant in Aurora, Colorado. Born in Milwaukee, he served this past year as chairman of the Executive Committee of the Transportation Research Board. He was secretary of the Department of Transportation in the State of Wisconsin (1979-1981, 1983-1986) where he also served as secretary of the Department of Labor (1981-1982), and was director of the Colorado Department of Highways (1987). His civil engineering degrees are from Purdue University (1957, 1959), where he was a member of the faculty (1957-1965). He also was a tenured faculty member at the University of Wisconsin (1965-1978). Mr. Jackson was appointed to the Council by President Reagan.

Frieda K. Wallison

Partner of the law firm of Jones, Day, Reavis & Pogue. Born in New York City, she previously served as executive director and general counsel of the Municipal Securities Rulemaking Board (1975-1978). She also was special counsel of the Securities and Exchange Commission (1975). She was a member of the National Council on Governmental Accounting, and now serves on the Governmental Accounting Standards Advisory Council. She is a graduate of Smith College (1963) and holds an LL.B. from Harvard University (1966). Mrs. Wallison was appointed to the Council by President Reagan.

Nancy S. Rutledge,
Executive Director

Former director of the Washington State Public Works Project (1982-1985). Prior to joining the Council, she was an investment banker with the firm of Seattle-Northwest Securities, Inc. (1985). Born in Olympia, Washington, she is a graduate of Pacific Lutheran University (1970) and holds a master's degree in public administration from the John F. Kennedy School of Government at Harvard University (1979).

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Fragile Foundations:
A Report on America's Public Works

Final Report to
the President and the Congress

National Council on Public Works Improvement

February 1988

Joseph M. Giglio, Chairman

Senior Managing Director of Public Finance for the investment banking firm of Bear, Stearns & Co., Inc. Born in Bayonne, New Jersey, he previously served as a cabinet officer under Governor Hugh Carey of the State of New York (1977). He was Chairman of the U.S. Senate Budget Committee's Private Sector Advisory Panel on Infrastructure Financing (1985–1987). He is a graduate of Rutgers University (1967), and holds master's degrees in public administration from New York University (1972) and in business from Columbia University (1977). Mr. Giglio was appointed to the Council by the President pro tempore of the U.S. Senate.

Peter C. Goldmark, Jr.

Former Executive Director of the Port Authority of New York and New Jersey (1977–1985); currently Group Vice President, Eastern Newspapers for the Times Mirror Company. Born in New York City, he served as Director of the Budget for the State of New York (1975–1977) and Secretary of Human Services for the Commonwealth of Massachusetts (1971–1975). He is a graduate of Harvard College (1962). Mr. Goldmark was appointed to the Council by the Speaker of the U.S. House of Representatives.

Freeman Holmer

Former Vice Chancellor for Administration of the Oregon State System of Higher Education (1969–1979); currently President of the City Council of Eugene, Oregon. Born in St. Paul, Minnesota, he previously served as Director of Environmental Protection for the State of Wisconsin (1966–1968) and Director of Finance and Administration for the State of Oregon (1959–1966). He is a graduate of Concordia College (1938) and holds a master's degree from the University of Oregon (1946). He was professor of political science at Willamette University (1949–1959) and at New York University (1946–1949). Mr. Holmer was appointed to the Council by President Reagan.

Lowell B. Jackson

Registered Professional Engineer, currently a private consultant in Aurora, Colorado. Born in Milwaukee, he served this past year as Chairman of the Executive Committee of the Transportation Research Board. He was Secretary of Transportation in the State of Wisconsin (1979–1981, 1983–1986) where he also served as Secretary of Labor (1981–1982), and was Director of the Colorado Department of Highways (1987). His civil engineering degrees are from Purdue University (1957, 1959), where he was a member of the faculty (1957–1965). He also was a tenured faculty member at the University of Wisconsin (1965–1978). Mr. Jackson was appointed to the Council by President Reagan.

Frieda K. Wallison

Partner in the law firm of Jones, Day, Reavis & Pogue. Born in New York City, she previously served as Executive Director and General Counsel of the Municipal Securities Rulemaking Board (1975–1978). She also was Special Counsel of the Securities and Exchange Commission (1975). She was a member of the National Council on Governmental Accounting, and now serves on the Governmental Accounting Standards Advisory Council. She is a graduate of Smith College (1963) and holds an LL.B. from Harvard University (1966). Mrs. Wallison was appointed to the Council by President Reagan.

Nancy S. Rutledge, Executive Director

Former Director of the Washington State Public Works Project (1982–1985). Prior to joining the Council, she was an investment banker with the firm of Seattle-Northwest Securities, Inc. (1985). Born in Olympia, Washington, she is a graduate of Pacific Lutheran University (1970) and holds a master's degree in public administration from the John F. Kennedy School of Government at Harvard University (1979).

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Preface

The National Council on Public Works Improvement (the "Council") was created by the Public Works Improvement Act of 1984 (P.L. 98-501) to assess the state of América's infrastructure. The results of that evaluation are presented in a three-part document, *Fragile Foundations: A Report on America's Public Works.*

- Part One summarizes the Council's findings and its conclusions about the capacity of the nation's infrastructure to support future economic growth. It also outlines the Council's proposed strategy for strengthening these facilities and restoring a clear commitment to the future.
- Part Two provides a synthesis of major themes from over 5000 pages of research material prepared for the Council during the past two years. All of the research findings were reviewed and commented on by a wide range of public works experts in dozens of working group meetings, public hearings, and other public forums.
- Part Three is an Appendix that analyzes the performance of eight major categories of public works.

The three parts of this report represent the Council's final submission to the President and the Congress. This document is Part One of that report.

The Council's first report, *The Nation's Public Works: Defining the Issues*, provided an overview of current knowledge and set a broad context for further discussion and research. The issues included public works needs, economics and finance, government roles, management and decision making, and technological innovation. That report was submitted to the President and the Congress in September 1986.

The second report took the form of a series of study papers commissioned by the Council from independent consultants on nine categories of public works facilities and services: highways, streets, roads, and bridges; airports and airways; mass transit; intermodal transportation; water resources; water supply; wastewater management; solid waste; and hazardous waste. Each paper addressed the main issues identified by the Council in its first report. In the final chapter of each paper, the consultants provided the Council with their own views on major policy options in that category. These recommendations were reviewed by the Council but have not necessarily been incorporated into the Council's final policy conclusions. The entire series was transmitted to the President and the Congress in May 1987.

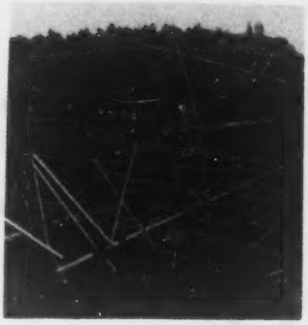
The Council also commissioned several analyses of cross-cutting themes that emerged from earlier work. These included: the role of dedicated revenues and special districts in funding public works; the unique problems of small public works systems; the link between infrastructure and economic activity; how other nations view infrastructure in their economic development efforts; the adequacy of the nation's public works; and improving the performance of public works through better management and decision making.

The Council has found much that is good about what cities, counties, special districts, states, and the nation are doing in planning, building, operating, and maintaining America's infrastructure. But on balance, the Council concludes that our infrastructure is inadequate to sustain a stable and growing economy. As a nation, we need to renew our commitment to the future and make significant investments of our own to add to those of past generations.

The Council and its staff are proud to report that the Council completed its work within its budget allocation and by the deadline established by the Congress.

Summary of Findings

The quality of a nation's infrastructure is a critical index of its economic vitality. Reliable transportation, clean water, and safe disposal of wastes are basic elements of civilized society and a productive economy. Their absence or failure introduces an intolerable dimension of risk and hardship to everyday life, and a major obstacle to growth and competitiveness.



The Erie Canal; the transcontinental railroads; the great dams and water systems of the west; the airports, seaports, and transit systems that serve our cities; our network of modern highways and soaring bridges—all these are part of this country's great public works inheritance from the generations of Americans who built before us. These massive and sometimes daring achievements supported the growth of the greatest economic power the world has ever known. They have been the envy of other countries and the model for our competitors.

Now that inheritance is in danger.

After two years of study, the National Council on Public Works Improvement (the "Council") has found convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements, and insufficient to meet the demands of future economic growth and development.

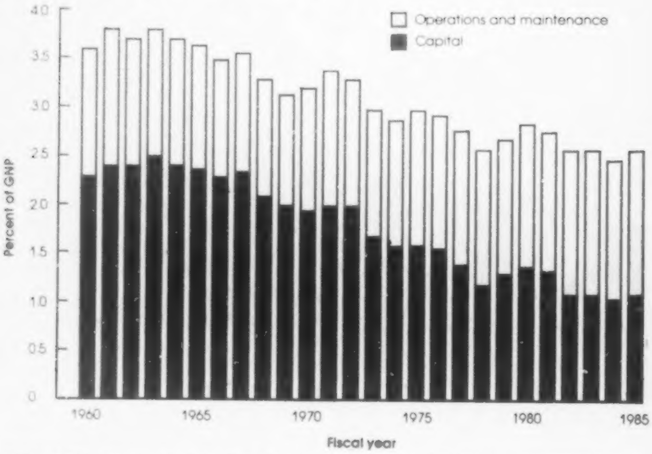
And unless we dramatically enhance the capacity and performance of the nation's public works, our own generation will forfeit its place in the American tradition of commitment to the future. Without such an effort, our legacy will be modest at best. At worst, we will default on our obligation to the future, and succeeding generations will have to compensate for our failures.

> *"We're spending our inheritance. You know, we built this freeway system . . . in the '50's and '60's, and we are still trying to make that do for today's needs."*
>
> Secretary Dewey Lonsberry,
> New Mexico Dept. of Highways
> and Transportation
> Council Hearing,
> Los Angeles, July 29, 1987

At present, most major categories of public works in the United States are performing at only passable levels. A few, such as water supply and water resources, remain in reasonably good shape. But others, such as solid waste and hazardous waste disposal, have serious and growing problems. In addition, smaller systems—in all categories and in nearly all regions of the country—face especially acute difficulties.

Part of the problem is financial. Overall investment in public works has slowed in the last two decades in relation to the demands of growth and environmental concerns. We have worn through the cushion of excess capacity built into earlier investments. In effect, we now are drawing down past investments without making commensurate investments of our own. Fig-

Figure 1—Public works outlays as a percent of GNP



Sources: U.S. Office of Management and Budget, *Budget Appendices of the United States*; U.S. Department of Commerce, Bureau of the Census, *Government Expenditure Series*; and *The Economic Report of the President*, for various years.

ure 1 illustrates this pattern of decline in public works spending as a percent of GNP.

With nearly one trillion dollars of public works assets[1] in the United States, reduced spending over the short term does not mean that individual facilities are in imminent danger of collapse, or that particular regions are in immediate peril. However, a declining infrastructure inevitably will jeopardize the productivity of our economy and our quality of life. Failure to reverse this decline will exact a high price for the nation in the future, both in the cost of deferred investment and in reduced economic competitiveness.

Therefore, the Council recommends a national commitment, shared by all levels of government, the private sector, and the public, to vastly improve America's infrastructure. Such a commitment could require an increase of up to 100 percent in the amount of capital the nation invests each year in new and existing public works. In 1985, this amount was approximately $45 billion.

Dramatically expanding current capacity or doubling the rate of capital spending is not an absolute requirement in all infrastructure categories, at all levels of government, or in all regions of the country. However, an increase in capital spending of this magnitude is an important and achievable goal for the nation as a whole by the end of this century. For some categories, such as hazardous waste disposal, an even greater effort may be warranted.

---

[1] This represents the approximate cumulative depreciated value of the public works facilities in the Council's purview. These include: highways, mass transit, aviation, water resources, water supply, and wastewater, solid waste and hazardous waste disposal. Public works can be interpreted more broadly to include communications, energy facilities, schools, hospitals, prisons, and parks. In an effort to target its resources, the Council has limited its primary focus to transportation, water, and waste disposal issues. Nevertheless, a considerable portion of its research findings and policy conclusions may apply to other areas.

A strategy to upgrade America's infrastructure must incorporate other tactics in addition to increased investment. **Thus the Council also recommends:**

- **Clarification of the respective roles of the federal, state and local governments in the construction and management of infrastructure to focus responsibility and increase accountability;**
- **Steps to improve the performance and efficiency of existing facilities;**
- **A rational capital budgeting process at all levels of government;**
- **Strong incentives to ensure adequate maintenance and, where appropriate, adopt new technologies; and**
- **More rigorous and widespread use of low capital techniques for delivering services and meeting service needs, such as demand management, coordinated land-use planning, and waste reduction and recycling.**

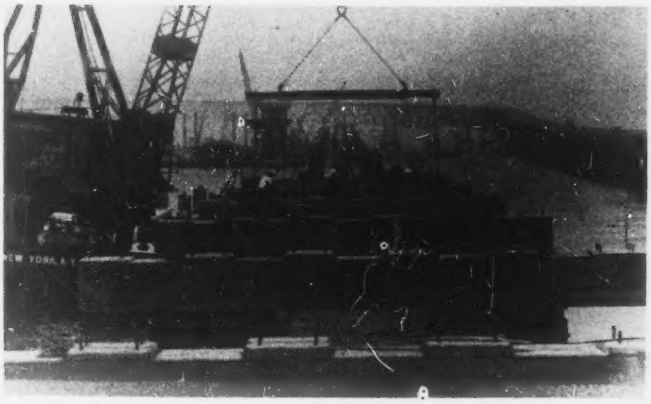
Through these measures the nation can make the best use of existing assets. This approach also may help to defer or avoid a significant portion of capital needs and costs that otherwise would be required in the future.

> *"Where in this myriad of problems is the good news? I would suggest that it lies in the opportunity to get government moving before an infrastructure crisis is upon us."*
>
> Michael Deland,
> Regional Administrator, EPA,
> Boston, Massachusetts
> Council Hearing,
> Boston, Aug 3, 1987

The Council recommends that state and local governments continue to play their traditional leadership roles in the construction and management of the nation's infrastructure. But the Council also believes that the federal government must act as a full and responsible partner on a long-term basis in the national effort to increase and sustain public capital investment.

There is much to set right in America's house. The Council recognizes that an increased investment in infrastructure is just one among many critical claims on the nation's resources. To address this claim and others requires that we reckon first with the growing imbalance between consumption on the one hand and investment and savings on the other. This imbalance, reflected in the federal budget deficit and in other forms of borrowing against the future, affects all federal spending decisions. **The Council supports appropriate actions to redress the imbalance between consumption and savings so that future infrastructure commitments will not be shortchanged.**

The Council believes that infrastructure must rank high among our priorities. We must ensure that our highways and subways can move us swiftly and safely; that our homes, farms, and industries are supplied with ample clean water; that we re-



duce and safely dispose of the increasing volume of poisonous wastes our society generates; and that we provide the structural underpinning for a robust and competitive economy.

To reach this goal by the turn of the century, we must start now to rebuild what we have neglected, to repay where we have borrowed, and to invest again in our future and our children's future.

Joseph M. Giglio

Joseph M. Giglio
Chairman, New York, New York

Peter C. Goldmark Jr.
New York, New York

Lowell B. Jackson

Lowell Jackson
Aurora, Colorado

Freeman Holmer

Freeman Holmer
Eugene, Oregon

Frieda K. Wallison
Washington, D.C.

Reinvesting in America

Sharply upgrading America's infrastructure is an ambitious goal. It cannot be achieved in a short period. Our infrastructure problems are manageable, but only if we begin to mobilize our resources now. These problems cannot and should not be solved through a crash program. Rather, success requires that all levels of government and the private sector dedicate themselves to a sustained effort.

This effort should focus on the effective capacity of our infrastructure systems—the level and quality of public services provided by each category. No single approach by itself will be adequate. More money alone will not suffice. More effective management alone will not get the job done. Technology will not save the day. The complexity of these systems and their attendant problems demand a broad-based strategy.

> *“. . . there is no ‘quick-fix’ for the problem. It's much more likely to be solved—eventually—through deliberate remedial steps rather than through a fast, dramatic ‘conversion’ of practices and attitudes.”*
>
> Mayor George Latimer
> City of Saint Paul, Minnesota
> Letter to the Council
> June 22, 1987

Rating America's Infrastructure Performance

To determine where we must go, we first must assess where we are. The current condition of the nation's infrastructure is hardly encouraging. If our public works were graded on an academic scale, their recent performance would earn a scant "C"—barely adequate to support current demands.

Yet a single grade cannot reflect the variability of performance by category or within categories. For example, municipal refuse is collected with some success, but limited landfill capacity is making disposal more expensive and less effective.

The report card on the following page provides an overview of the performance of eight categories of public works. By identifying recent program changes and outstanding policy concerns, it also highlights opportunities for improvement.

> *“The public needs to understand that major public works projects have a tremendous lead time, especially if they are located in a metropolitan area or involve controversy. It took more than 20 years from inception to the opening of Interstate 66 from the Capitol Beltway to the city of Washington, D.C.”*
>
> Albert A. Grant, P.E., President,
> American Society of Civil Engineers

REPORT CARD ON THE NATION'S PUBLIC WORKS

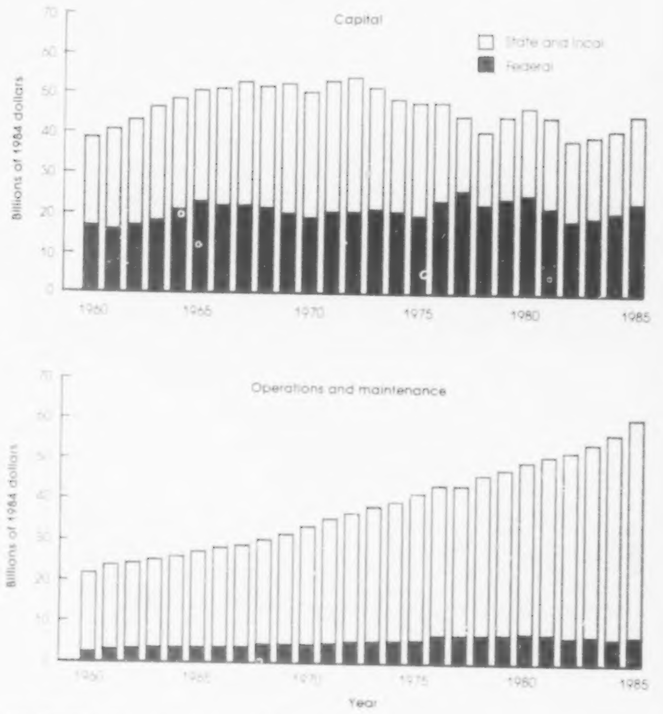
Subject Category	Grade	Successes/ Recent Changes	Problems/ Future Weaknesses
HIGHWAYS	C+	Federal and state gas tax increases have injected new capital into the system. This, along with inceased O&M spending, has improved pavement conditions. However, quality of service in terms of congestion is declining.	Spending for system expansion has fallen short of need in high-growth urban and suburban areas. Many roadways and bridges are aging and require major work. Needs of most rural and smaller systems exceed available resources. Highway Trust Fund has a sizeable cash balance.
MASS TRANSIT	C-	Federal capital grants have helped improve quality of service in some areas, but overall productivity of the system has declined significantly. Growth of transit vehicles is double the rate of increase in ridership. Diverting people from cars is increasingly difficult.	Mass transit is overcapitalized in many smaller cities and inadequate in large, older cities. Systems rarely are linked to land-use planning and broader transportation goals. Maintenance has been erratic and inadequate, especially in older cities.
AVIATION	B-	In general, the aviation system has handled rapid increases in demand safely and effectively. However, service has begun to decline in the face of increasing airport and airspace congestion as a result of strong traffic growth. The air traffic control system is currently undergoing a $16 billion modernization.	Congestion is the system's primary problem. Despite recent increases in authorizations, sizeable cash balance remains unspent in the Airport and Airway Trust Fund. The air traffic control system needs substantial upgrading to maintain safety.
WATER RESOURCES	B	Water Resources Act of 1986 made cost-sharing mandatory for many types of water projects. This change should improve project selection and reduce overall project costs.	Cost-sharing will improve efficiency but also increase local costs of water projects. Poorer communities may find it difficult to finance projects. Implemeniation is often excessively slow and cumbersome.
WATER SUPPLY	B-	While regional performance varies, water supply stands out as an effective, locally-operated program. Strict new standards created by the 1986 Safe Drinking Water Act will require drastic increases in water rates over the next decade.	Many public water systems suffer from pricing below costs, inability to meet purity standards, or source contamination. Storage and distribution systems are deteriorating in some older cities and supplies are limited in some parts of the West and several cities along the East coast.
WASTEWATER	C	Over 75% of U.S. population is served by secondary treatment plants. Shift from federal grants to state revolving loans may improve efficiency of plant construction. Broadened focus on nonpoint source pollution and groundwater contamination may accelerate progress toward cleaner water.	Despite $44 billion federal investment in sewage treatment since 1972, water quality has not improved significantly. This is due in part to uncontrolled sources of pollution, such as run-off from farmland and roadways. Overall productivity of secondary treatment facilities is declining, resulting in an increase in water quality violations.
SOLID WASTE	C-	Testing and monitoring of solid waste facilities are more rigorous as a result of tougher environmental standards. Waste-to-energy technology is growing as alternative to landfills. More aggressive waste reduction, separation, and recycling efforts are beginning at the local level. However, few states have moved boldly on these measures.	Nation faces significant costs of adequate and safe facilities. Limited data suggest trends toward fewer but safer landfills, rapid growth in resource recovery, and little progress toward waste reduction. Public opposition to siting all types of facilities is a major problem.
HAZARDOUS WASTE	D	Funding for site clean-up has increased five-fold since 1986, but progress has been slower than expected. Only a small fraction of the two tons of waste per capita produced in America each year is being treated safely. Major challenge is still ahead of us.	Nation has forfeited much of its opportunity to reduce waste before it is produced. Waste control legislation promotes "end-of-pipe" rather than source reduction solutions. Congressional mandates and schedules may be overly optimistic, given administrative resources. A massive backlog of poisons and needed cleanup projects faces the nation.

Current Spending on Public Works[2]

Capital investment represents front-end, long-term resources committed to the plant and rolling stock that provide public works services. Measured in 1984 dollars, state and local capital investment peaked in 1972 at $34 billion; annual federal outlays for capital, however, peaked at $25 billion in the late 1970s. This trend is charted in Figure 2.

Spending for operations and maintenance (O&M) is key to the overall longevity and efficiency of public works capital assets. In the aggregate, spending for O&M has continued to grow at a rapid rate since the 1960s (from $21.6 billion in 1960 to $56.5

Figure 2—Government outlays for public works



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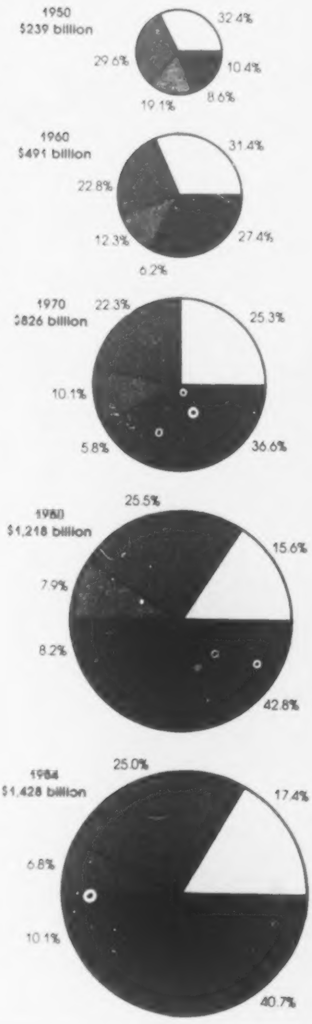
[2] All dollars are expressed in constant 1984 dollars, unless otherwise noted in the text.

billion in 1984), as also shown in Figure 2. Underlying this trend was a small decline in federal operating outlays since the mid-1970s and a substantial increase in local O&M outlays over the entire 24-year period.

Public works spending patterns are of particular concern when viewed in relation to other measures of economic activity. For example, total public spending on infrastructure has dropped from 3.6 percent of the gross national product (GNP) in 1960 to 2.6 percent in 1985. While spending on operations and maintenance has remained a constant share of GNP, capital spending has dropped from 2.3 percent of GNP in 1960 to 1.1 percent today. The relative share of public works spending at all levels of government has declined drastically from nearly 20 percent of total expenditures in 1950 to less than 7 percent in 1984, as shown in Figure 3. During this same period, government spending for welfare and education increased from 10 percent to over 40 percent of total expenditures.

> *"There is growing concern at the state and local level that given competing demands for funding at the local level for education, health, welfare and public safety programs, the public works infrastructure may indeed experience severe deterioration in the coming years.*
>
> **Harout Sanasarian**, Supervisor
> **Milwaukee County**, Wisconsin
> Council Hearing,
> Indianapolis, July 12, 1987

Figure 3—All government spending, 1950–1984 in 1984 dollars



1950 $239 billion
1960 $491 billion
1970 $826 billion
1980 $1,218 billion
1984 $1,428 billion

☐ Defense
■ Nondefense discretionary
■ Public works
■ Interest on general debt
■ Public welfare/education

Source: Apogee Research, Inc.

Public works investment is growing more slowly than private capital investment. Private-sector capital investment increased by about 51 percent between 1975 and 1985, but public works investment fell by more than 6 percent over the same period. Figure 4 shows the decline in public works spending per dollar of new private capital put in place.

Economic Prognosis

What do these trends mean for the health of the economy? The level of public works spending is only one indicator of the quantity and quality of service. However, we do know that public investment generally increases the productivity of private investment. Thus the growing imbalance between public and private investment means that we probably are not getting as much value as we could for every private investment dollar. The resulting loss in productivity limits the growth of the economy and our ability to compete in world markets.

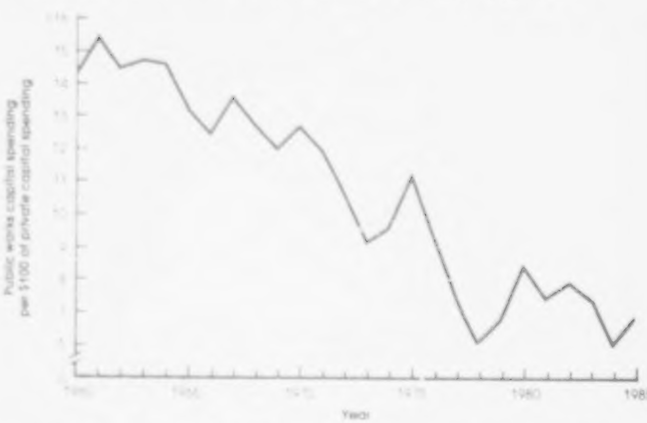
In light of these spending trends and the concerns about future performance outlined above, it is clear that substantially more must be done—and we must start soon.

> *"For the sake of our nation's future, we must provide the funds necessary to maintain and improve roadways and bridges. These are the networks essential for our economic survival."*
>
> James Sullivan, President,
> Greater Boston Chamber of Commerce
> Council Hearing,
> Boston, Aug. 3, 1987

Elected officials and the public at large must recognize that capital expenditures are not the only cost of public works; rather, the expense incurred through delays in providing needed services, added to the value of lost economic opportunities, often can exceed direct budget costs.

> *"The long pattern of disinvestment and a deteriorating infrastructure have eroded our capacity to sustain economic growth—growth which is translated directly into jobs for Americans."*
>
> The late
> **Mayor Harold Washington**
> City of Chicago
> Council Hearing,
> Chicago, Sept. 30, 1987

Figure 4—Comparison of public works capital spending to private capital spending



[illegible] Report of the President, January 1987 [illegible]

Our current level of capital investment is barely enough to offset annual depreciation, much less meet new demands. The U.S. Department of Commerce estimates that infrastructure use by industry alone will increase by at least 30 percent over the next ten years as a result of economic growth, the dispersion of population and economic activity, and technological and structural changes. Infrastructure capacity must keep pace with this increase while still maintaining the current quality of service. Better service—reduced congestion, improved water quality, higher safety levels—will require even greater capacity expansion, as well as extensive operational improvements.

"The condition of our transportation infrastructure is a critical factor in determining our nation's productivity and our ability to compete and survive in today's world market. We face widespread economic decline if we allow our tremendous highway infrastructure investment to deteriorate."

Commissioner Leonard Levine,
Minnesota Department of
Transportation
Council Hearing,
Chicago, Sept. 30, 1987

"Currently the cost of congestion in Los Angeles County is about 485,000 hours per day of wasted time by our residents or people driving through the county. That converts . . . by our estimates to a minimum of about $507 million per year in wasted time, and about 72 million gallons of gasoline . . . just in our county."

Rich Richmond, Executive Director,
Los Angeles County
Transportation Commission
Council Hearing,
Los Angeles, July 29, 1987

While a sound infrastructure does not guarantee future prosperity, long-term economic growth cannot be achieved without it. Economic efficiency and public health both are linked inextricably to adequate transportation, water quality, and waste disposal services. In addition, infrastructure investment directly supports additional economic activity. For every public dollar spent on an annual basis to build and maintain our network of roads, streets, and bridges, the private sector spends $15 to move people and goods. For every public aviation dollar, private firms and individuals spend nine.

If we spend too little on public works or if we invest in inefficient projects, society loses more than the direct public cost. In the long run, our ability to compete in the international economy will be weakened, and our standard of living will suffer.

Finding the Money

Much of the discussion about public works in recent years has focused on choosing appropriate finance mechanisms—e.g., revolving loan funds, intergovernmental grants, tax-exempt debt techniques, or various forms of privatization. While these options may differ in terms of the attractions they offer to public officials, they all draw on two basic sources of funds—*general tax revenues* and *user fees*.

Mobilizing adequate financing to meet our current and future public works needs requires participation by all levels of government. **The Council endorses the following principles to guide this effort:**

- **Users and other beneficiaries should pay a greater share of the cost of infrastructure service.**
- **The federal government should be a reliable partner in financing public works.**
- **States should develop comprehensive infrastructure finance strategies.**
- **Local governments should give budgetary priority to funding the maintenance of existing facilities.**

Emphasis on the Beneficiaries

Today almost 75 percent of public capital spending on infrastructure is derived from users. Yet only about 50 percent of spending on operations and maintenance comes from this source. Significant elements of transportation, water supply, wastewater treatment, and solid and hazardous waste systems serve identifiable consumers on a continuing basis. Use can be measured and priced; those who do not pay can be excluded from services. Linking financing to use can produce a steady and predictable revenue stream, encouraging better maintenance, rehabilitation, and replacement.

> *"New strategies like public-private partnerships will help. So will federal initiatives. . . . But what I think is really needed first is a national consensus. We need to better define the scope of the problem—what are the specific needs for all levels—and then identify what resources can be marshalled and by whom."*
>
> Mayor Don Erickson,
> Cheyenne, Wyoming
> Council Hearing,
> Los Angeles, July 29, 1987

The Council recognizes important limitations to the user fee principle. Many smaller communities lack the financial base necessary to finance a facility—especially when new capital investment is required. Fees for certain types of essential services, such as water supply, sewage treatment, and solid waste disposal, also can be excessively expensive for lower income residents or hard-to-serve areas.

Options to address these problems may include guarantees or insurance for small-issue debt; state bond banks that combine small bond issues into larger, more creditworthy statewide issues; selected increases in grants targeted to smaller facilities or those serving lower income areas; and regionalization of services to achieve economies of scale. Providing a threshold level of service and a safety net in these instances also may require general revenues to supplement user fees.

Public works produce both direct and indirect benefits. For example, a mass transit system benefits the transit riders as well as the motorists who travel in the area. In addition, mass transit often benefits business and commercial interests. Thus, the cost of transit development or expansion should be borne by all three groups.

> *"Twenty years ago developers looked almost entirely to the public sector for infrastructure. Today with increasing population and migration of people and businesses to the cities and surrounding counties of Nashville growing so much faster, the public sector can no longer provide total infrastructure needs. The future must be a joint effort."*
>
> George Volkert, President
> Southeast Venture Company
> Nashville, Tenn.
> Council Hearing, Nashville, June 9, 1986

User fees may prove inadequate for many new investments in infrastructure technology and economic development. Such projects have few immediate or easily identifiable beneficiaries. Instead, they represent long-term commitments to the future, and rightfully are a matter of common responsibility, to be financed out of general funds or a user fee base that includes both present and future beneficiaries.

The Council endorses the general principle that developers should pay an equitable portion of the cost of new facilities necessary to service commercial, industrial, and residential development. State and local officials should exercise due care to see that the allocation of such costs is fair and reasonable and does not result in undue private influence over public development policies and priorities. Further, it should be recognized that developer fees and exactions will have an impact on the cost and availabilty of housing.

The Council urges that federal user fees paid in good faith by beneficiaries to preserve and protect public works systems be spent for that purpose. The accumulation of unspent balances in the federal highway, transit, aviation, and waterways trust funds—nearly $24 billion in the 1987 budget—is at odds with this principle. **The Council supports a determined, incremental effort to reduce these balances—in line with responsible management and planning—so that the funds can be used for necessary infrastructure improvements.**

Federal Partnership

Between 1960 and 1975, federal grants-in-aid as a portion of total state and local capital spending remained relatively stable at about 33 percent (Figure 5). In the late 1970s, federal aid rose to more than 50 percent; since then it has leveled off at 40 to 45 percent. These patterns reflect a decline in capital spending by state and local governments as well as shifts in federal grant policy.

In the realm of infrastructure finance, the federal government traditionally has focused on providing public works capital. Because of its limited involvement in maintenance and operations, the federal government accounts for less than 30 percent of all public works spending.

The Council urges the President and the Congress to recognize the importance of maintaining a continuing federal role in infrastructure finance. Intergovernmental aid still is necessary to launch major projects of national interest, or to help governments with limited fiscal capacity. However, some changes in the form of federal spending may be necessary to accommodate shifting federal, state, and local roles and relative fiscal capacities.

"I think we have seen the end of … massive amounts of federal dollars returning to local governments through federal revenue sharing and any grant program. I think at the state and local levels we must … go to Washington and ask for programs and policies that are feasible in light of the changed fiscal circumstances."

Ronald Bean, Executive Director,
Illinois Development Finance Authority
Council Hearing,
Chicago, Sept. 30, 1987

Whatever form federal assistance takes, it should offer state and local governments:

- Stability over several years to aid long-range planning;
- Flexibility in the use of funds through such mechanisms as block grants; and
- Incentives for increased efficiency and improved maintenance.

In addition, the federal government should exercise restraint in adopting legislation that would limit the revenue-raising capacities of state and local governments.

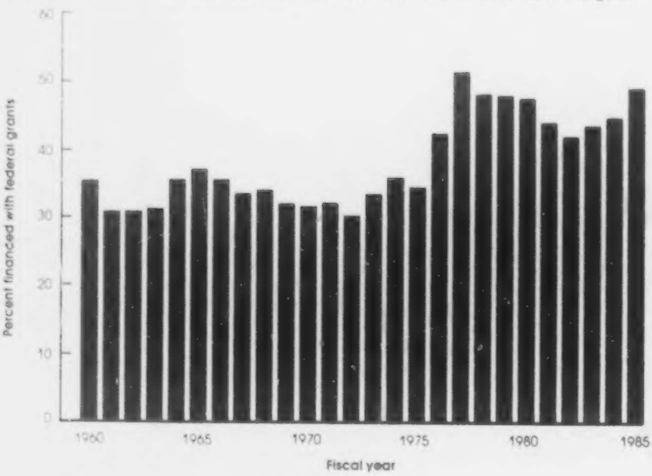
Federal tax policy also has a significant impact on infrastructure finance. For example, the Tax Reform Act of 1986 drastically limits arbitrage earnings on borrowed funds and restricts the use of municipal bond proceeds for quasi-public projects by imposing ceilings on allowable issues. These and other provisions are expected to limit the growth of tax-exempt bonds, and to increase state and local borrowing costs. The law also lengthens depreciation schedules and repeals investment tax credits, which will increase the cost of joint development of certain public works with the private sector. In combination, the provisions of the 1986 law may impede the financial plans of state and local governments, reduce their fiscal capacity, and limit their ability to finance necessary improvements.

The Council urges the President and the Congress to pay close attention to the effects of tax reform, and to remove unwarranted limitations on the power of state and local governments to finance public works.

State Strategies

Although a number of states have instituted innovative financing programs, the state share of overall spending on infrastructure dropped from 32 percent in 1970 to 23 percent in 1985. At $25 billion annually, state

Figure 5—Percent of state and local public works capital spending financed with federal grants



Source: Apogee Research, Inc., Government expenditures databases.

taxes and fees now finance less than one-third of expenditures on state and local public works programs.

While localities are under pressure to fund an increasing portion of total public works spending, often they must contend with state restrictions on taxation or bonding. For example, as of 1985, 31 states had imposed specific property tax rate limits on local governments. Six states had either constitutional or statutory limits on the total amount of revenues that local governments could collect annually.

The Council encourages governors and state legislatures to examine the impact of such restrictions on state and local public works. Where state constitutional or statutory limitations hinder the ability of the state and local jurisdictions to deliver essential services or adversely affect their credit ratings and finance capacity, states should assume responsibility for either remedying the situation or providing compensatory assistance.

> *"We as local communities are property tax dependent. We have no access [illegible] and it is true in most all New England states [illegible] other forms of taxation."*
>
> Pam Plumb, City Council Member, Portland, Maine, and 1988 President of the National League of Cities
> Council Hearing,
> Boston, Aug 4, 1987

Future Finance Options

The Council has called for a substantial increase in the capacity and effectiveness of the nation's public works. This goal is not attainable unless we first make better use of existing financial resources. In most cases, however, we cannot rely simply on wiser spending; we also must generate additional sources of funding. This burden will fall on all levels of government and involve virtually every category of public works.

The Council supports the concept that the unit of government responsible for service delivery should be the one that levies the fees or taxes to the extent possible and practical. This will strengthen accountability for the cost and quality of public works service. Local governments already bear the lion's share of operating and maintenance costs and a growing portion of capital costs as well. But to carry out their responsibilities, they must have the proper tools, such as taxing and bonding authority and access to the tax-exempt municipal bond market.

> *"One point seems to be very clear. The people are willing to dig into their own pockets to pay for better roads, more schools, clean water, expanded airports, improved transportation, and the items which help shape the quality of life in the Golden State."*
>
> Don McGrew, President,
> Griffith Company,
> Long Beach, California
> Council Hearing,
> Los Angeles, July 29, 1987

It is not appropriate for the Council to propose a specific legislative program of new fees and taxes to finance public works improvements. The most equitable and efficient mechanisms will depend on the type of infrastructure problem being addressed and on local conditions, traditions, and institutions. These trade-offs are made through the political process at all levels of government. The menu of possible revenue sources listed in Table 1 provides a starting point for assembling such a program.

Many of the options in Table 1 represent simple expansions of existing user fees or related excise taxes. The largest potential sources of funding are motor fuel taxes used by the federal and state governments to support highways and some transit spending, and developer exactions and related fees imposed by many local governments. Local exactions are perhaps the fastest growing means of infrastructure finance, as well as the least well known.

Table 1.—Possible Sources of New Public Works Revenues

Source	Level of Government	Current Rate	Possible Increment	Potential Revenues ($ millions/year)
Motor Fuels Tax				
a) Flat Tax	F,S,L	$0.23/gal[a]	$0.10/gal	$12,000
b) Ad Valorem	F,S,L	([b])	10% of fuel costs	9,500
Repeal Exemptions from Highway Taxes	F	([c])	N.A.	1,000
Heavy Truck Taxes	F,S			1,000
Aviation Ticket Tax	F	8% of value	2% of value	800
Airport Service Charge	L	None[d]	$3/passenger	1,500
Inland Barge Fuel	F	$0.10/gal[e]	$0.10/gal	50
Port Tax	F	0.04% of cargo value	0.06% of cargo value	250
Cash Balances in Trust Fund Cash	F	N.A.	([f])	2,000
Water Supply	F,S	None[g]	$0.10/1,000 gallons	750
Waste-End Taxes	F,S			
a) Generation		None	$5/ton	1,500
b) Disposal —by Hazard		None	$0–$60/ton	2,600
c) Disposal —by Method		None	$4–$25/ton	3,200
Local Impact Fees on Developers	L	([h])	([i])	10,000-15,000

NOTE: Revenue estimates show gross receipts and have not been adjusted for potential reductions in other taxes. These offsets could reduce gross receipts by as much as 25 percent.

SOURCE: Apogee Research.

[a] The current federal tax is 9 cents per gallon of gasoline. State taxes average 14 cents per gallon. The federal government taxes diesel fuel at an additional 6 cents per gallon.

[b] Some states currently collect sales taxes on motor fuel.

[c] State and local vehicles, transit buses and users of gasohol are exempt from certain federal and state taxes despite the wear and tear they cause on roads and bridges.

[d] This charge, commonly referred to as a "head tax," currently is prohibited by federal law.

[e] Scheduled to increase to 20 cents per gallon by 1995.

[f] Assumes the current trust fund cash balances will be used over the next ten years.

[g] None at the federal level. Washington is one of the few states with a water excise tax.

[h] Many local governments already impose some form of negotiated fee for the infrastructure costs resulting from new development.

[i] Assumes that impact fees and related techniques are increased to equal 20 to 30 percent of capital spending. Potential revenues are not likely to be realized until the mid-1990s.

16

Sharpening Accountability for Infrastructure

Dependable, high-quality infrastructure is not the product of money alone; building and maintaining public works requires a shared vision, commitment of time and energy, and the skills of people throughout the public and private sectors. Historically, such consensus often has been a local or regional phenomenon in America. The result is a system that is highly decentralized and subject to continual change. Each community has its own laws, traditions, and other characteristics that govern the way it apportions responsibility and resources for public works.

On the whole, this system has worked well in providing public works facilities and services for a large number of communities. But too often, when problems arise, ultimate responsibility among various levels of government is not understood clearly by either the public or its leaders. When the solutions are costly, complex, and controversial, or involve a wide range of players, our tendency, as individual communities and as a nation, is to stall and point our fingers at the "other guy" until we reach a crisis. By this time we generally have foregone the most sensible and inexpensive options. Last summer's story of the Long Island garbage barge wandering forlornly around the Caribbean is one such example. Most of its cargo was used paper—a commodity that could have been recycled for sale in many parts of the world. In the end, accountability was fixed back on the community that generated the garbage, but by then the cargo was waterlogged and without value.

The Council urges that the roles of the federal, state, and local governments be clarified to help boost the performance of the nation's public works.

In general, the Council believes the federal government should continue its primary role in hazardous waste disposal and cleanup, air traffic control, inland waterways, highways of national significance, intermodal freight transportation, minimum performance standards for environmental protection, major capital investments for flood control and shoreline protection, and the overall coordination of water resource programs.

> *"There is no perfect solution to solid waste disposal. . . . Everything we do will have some minor impact. . . . It must be disposed of and that place is inevitably in somebody else's backyard, and that is one of our problems."*
>
> Frank Borchardt,
> Executive Vice President,
> HDR Techserv,
> Omaha, Nebraska
> Council Hearing,
> Chicago, Sept. 30, 1987

In turn, states should have lead responsibility for highways of statewide significance, non-federal dam safety, major capital financing of wastewater treatment, airport system planning, and the siting of waste disposal facilities.

Local governments, or in some cases regional authorities, should have primary responsibility for local streets and roads, public transit, individual airports, water supply systems, ports, urban stormwater, wastewater treatment facilities, and solid waste disposal. In many instances, these services may be financed and operated by private firms through agreements with local jurisdictions. Opportunities for private participation should be considered actively by all levels of government but should not be seen as a panacea.

The impact and importance of most public works are not neatly locked within the boundaries of any given jurisdiction. One community's failure to provide good roads or adequate sewage treatment may hinder all others in the vicinity. Stewardship of the infrastructure as a whole demands some degree of accountability by all levels of government. However, in a dynamic and fractionated federal system such as ours, accountability can be measured more usefully against general principles than rigid standards.

The Council believes that state and federal infrastructure policy should support local self-sufficiency to the greatest extent possible. This means that:

(1) **Federal and state statutes should be far clearer and more rigorous in specifying who is responsible for doing what, and by what deadline.** Many laws and program guidelines governing complex projects contribute to delay and lack of accountability by failing to set timely deadlines for reviews. Nor do they specify who will resolve conflicting advice or opinions when many different agencies are involved. The immense difficulties of siting solid and hazardous waste facilities and the long, costly delays associated with port and navigation projects are reflections of this bureaucratic equivocation;

(2) **Federal and state public works mandates should be considered carefully and allow cost-effective methods of compliance rather than rigid technical requirements.** For example, in older urban areas, "dial-a-ride" services can provide equivalent mobility for the physically handicapped more cost-effectively than retrofitting all transit vehicles;

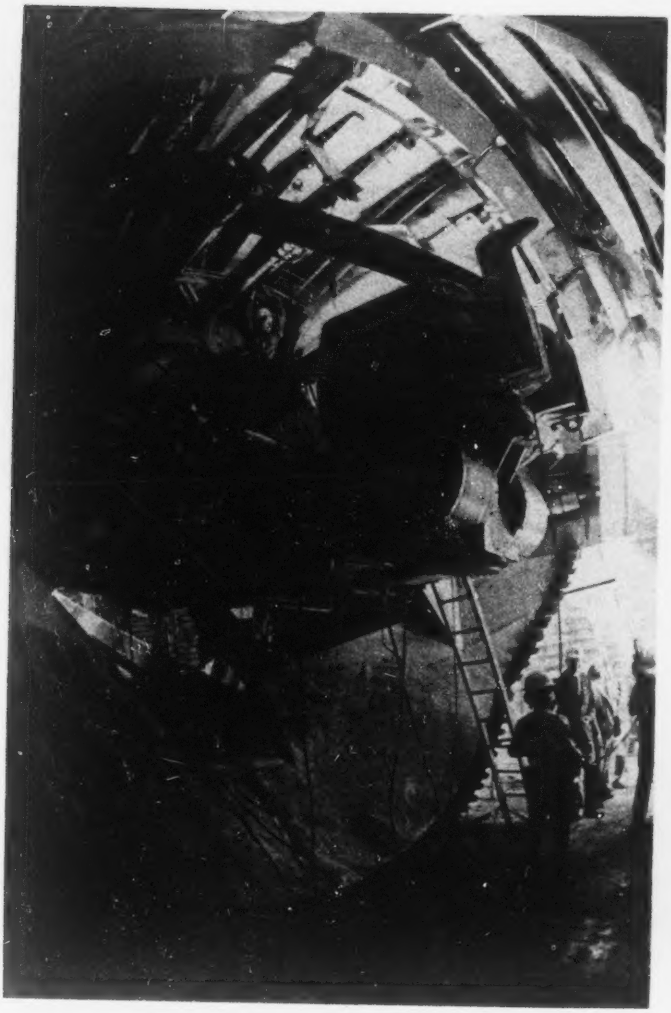
(3) **Rules governing state and federal programs should recognize the distinct financial and managerial needs of small and rural governments;**

(4) **States should seek to promote cooperation among local jurisdictions, as well as between state and local government.** State advisory councils on intergovernmental relations, regional planning commissions, councils of government, and interlocal agreements are useful mechanisms to achieve this goal; and

(5) **The federal and state governments should address the need for adequate technical information and expertise when they impose responsibilities on local government.** "Circuit riders" or other forms of technical assistance and training should be considered where appropriate.

There is an urgent need for the assignment of responsibility for the assurance of the integrity and safety of bridge structures. The current fragmentation among state agencies and separate authorities fails to provide the level of public protection for which government is ultimately accountable.

David Axelrod, M.D., Chairman,
New York State Disaster
Preparedness Commission
Memorandum to Gov. Mario M. Cuomo
on the Schoharie Creek Thruway
Bridge Collapse Report,
Dec. 2, 1987



Strengthening System Performance

The principal value of public works lies in the services they deliver—e.g. reliable transportation, clean water, and safe disposal of wastes. Physical assets, such as pipes, bridges, and lane-miles of freeway, make these services possible, but they come with no guarantee that they will deliver the quality, quantity, or cost of service needed to sustain our economy and standard of living. The performance of these assets depends on a range of human and technical factors, as well as the ongoing level of capital investment and maintenance.

If, as the Council recommends, the public is asked to provide increased capital for current and future infrastructure capacity, governments at all levels have a corresponding responsibility to get the maximum value out of every dollar spent. In many cases, it may be possible and prudent to postpone some new investment by increasing efficiency through improved operations, employing more aggressive maintenance procedures, and adopting various demand management techniques (such as full-cost pricing, land-use policies, or waste reduction and recycling).

Public works design, construction, operation, and maintenance should be viewed as phases of a single process. New equipment or facilities can be designed and built for ease of operation and maintenance. Timely repairs reduce long-term operating costs and ensure the full life expectancy of existing facilities and equipment. Innovative operations sometimes can add capacity for little cost and reduce maintenance needs (e.g., computerized traffic control systems and non-corrosive snow and ice melting compounds).

The Council encourages renewed attention at every level of government to maintaining our current assets to optimum standards. Maintenance is perhaps the single most important element of governments' stewardship obligation. It also is the element that is easiest to defer, and the one most likely to be cut from the current expense budget.

Maintenance must be made more visible. This means providing understandable information on infrastructure conditions, performance, maintenance costs, and the annual amounts of deferred maintenance.

> *"When highways and bridges are regularly maintained there is no press coverage. When they are rebuilt it is an 'event.' There is a ribbon-cutting and plenty of press coverage. The incentives, therefore, are for public officials to purposefully starve the maintenance budget. . . . Until this motivation . . . is acted upon, we will be treated to recurrent infrastructure crises. In fact, proposals for infrastructure bonds, banks, etc., only abet this whole process."*
>
> Edward V. Regan, State Comptroller
> State of New York
> Letter to the Council, January 15, 1988

It means actively educating the public—as shareholders in the nation's capital stock—to the importance of the *long-term* integrity of the system. In fact, public education is an important element of any strategy to improve our nation's infrastructure.

> *"One of the problems with the streets is that as you delay, the cost escalates. . . . If you allow them to fail without maintenance, then you are tripling or quadrupling . . . the cost to repair a street versus just maintaining it."*
>
> Robert Horii, City Engineer,
> Los Angeles Dept. of Public Works
> Council Hearing,
> Los Angeles, July 29, 1987

Other options that may help to lengthen the life of infrastructure systems include removing restrictions on federal and state grant funds to allow them to be used for improved operations and maintenance, and creating stronger maintenance incentives in revenue bond covenants.

The Council endorses a variety of operational improvements to increase current capacity and improve performance. For example, the primary problem with airport and airway facilities is congestion. However, new runways may not be the only answer; the solution at some airports may be to install available equipment that allows planes to depart and land safely at closer intervals. Demand management strategies, such as peak load landing fees, have reduced congestion at all three major airports serving the New York/New Jersey metropolitan area.

Demand for waste disposal facilities can be managed by waste reduction, separation, and recycling. Certain states have established goals of recycling anywhere from 15 to 40 percent of the waste stream. For example, ten states, including Oregon, Massachusetts, Maine, and Michigan, have implemented "bottle bills" to promote recycling and reduce waste. Massachusetts also is constructing a number of materials recovery facilities throughout the state.

Regulations governing product packaging can help reduce waste. Fees or surcharges on items that are difficult to dispose of (e.g., lead, zinc, or plastics) can reduce their use. Regulations requiring reuse of, or deposits on, recyclable items such as automotive batteries and motor oil serve the same purpose.

The Council strongly encourages all levels of government to upgrade the quality and quantity of basic public works management information in order to measure and improve system performance. At present, too many infrastructure investment decisions in America are made "by the seat of the pants." Small and medium-sized jurisdictions (and many large ones too) do not have complete inventories of existing facilities; most do not conduct regular surveys of the condition of public facilities or collect information on the quality, quantity, or cost of services. Only a handful of jurisdictions take advantage of established analytic techniques for computer mapping, life-cycle cost analysis, automated asset management, or precise tracking of growth trends.

While the up-front costs and paperwork required to set up data collection, management, and reporting systems can appear formidable, the absence of this information means that public officials must make multi-million dollar investment decisions on an *ad hoc* basis. The costs of estimating required capacity incorrectly or selecting a project ill-suited to needs can be staggering, particularly in the face of the fiscal and economic pressures facing most state and local governments.

In planning for public works investments, every jurisdiction should be guided by clearly stated performance objectives, consider alternative ways of achieving them, and have access to realistic information about costs of operation and maintenance. The capital budgeting process should

examine the entire range of public works needs to guarantee that the choices made reflect a rational set of priorities.

> *"Only with broad public understanding and support, especially as perceived by the responsible public officials, can any initiative or action involving political risk be successful."*
>
> Walter J. Olson, Program Director
> Build up Greater Cleveland
> Council Hearing, Chicago, Sept. 30, 1987

The private sector and a majority of state and local governments are setting the course and establishing proper standards for capital budgeting to meet generally accepted accounting principles (GAAP) and to gain a clearer picture of their capital needs and related financing requirements and resources.

> *In Madison, Wisconsin, a $40,000 public education campaign convinced many residents to shift their water use away from the 6 p.m. peak. The relatively modest investment averted the construction of a new well system once thought necessary to meet peak demands. Savings to the community were at least $750,000 in new well construction, plus some $60,000 a year in operating costs.*

The Council believes that the federal government should consider following their example. Capital budgeting at the federal level should seek to identify, define, and present separate operating and capital components of the federal budget while *maintaining a unified budget.* Direct federal spending on capital projects—such as roads and bridges, hospitals and housing, and military bases—and federal grants to state and local governments represent distinct forms of federal capital investment that may require different approaches. However, both can benefit from better planning and more consistent allocation procedures.

By requiring an annual analysis of federal capital spending, the Federal Capital Investment Program Information Act of 1984 (passed as Title II of P.L. 98-501 which established the Council) provided a constructive first step toward the development of an overall federal infrastructure strategy. **The Council urges the Congress and the President to institute capital planning and budgeting procedures as an integral element of the federal decision-making process. Such procedures would be the next logical step toward building a stronger fiscal—and physical—foundation for America.**

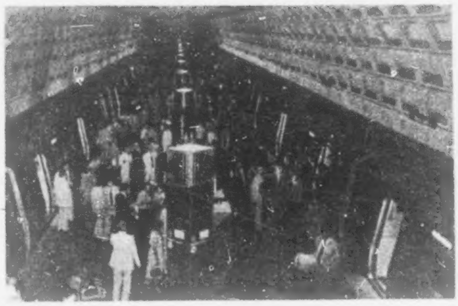
The City of Saint Paul offers one example of a far-reaching program designed to take advantage of computer technology and avert future crises. The first phase, Computerized Infrastructure Inventory, *was put in place in 1986, and provides a detailed data-base on the construction materials, location, age, and condition of all the city's public works facilities. The second phase,* Computerized Maintenance Management, *which began to be implemented this past summer, links inventory data to city maintenance schedules, requests for service, and maintenance results. The third phase,* Computerized Mapping, *will be installed in the next few years and is expected to provide a complete electronic map of all streets in Saint Paul. Public works managers will be able to "overlay" infrastructure information on this map in order to develop and analyze maintenance strategies.*

Accelerating Innovation

The strength of America's infrastructure systems directly reflects our capacity and commitment to renew and improve public works technologies and their applications. Such technologies range from sophisticated robotics for trenchless pipe-laying to the asphalt used to pave the streets. Their development, implementation, and maintenance depend on a combination of knowledge, materials, equipment, and skilled people. Innovative, up-to-date technologies can guarantee efficient, safe, effective service and contribute to economic growth. Outdated technologies may endanger public safety, increase the cost of service, and reduce the competitiveness of business and industry.

The Council finds that the level of effort and resources applied to infrastructure research and development (R&D) in the United States falls far short of current as well as future requirements. Federal spending on infrastructure R&D in 1985 was approximately $103 million, less than one third of one percent of total new infrastructure construction in that same year. This portion has been falling steadily in recent years, as has private sector spending on similar activities. The potential return on more research is enormous.

Such a decline in R&D is especially troubling in light of evidence that the nation is becoming more dependent on foreign producers in certain public works categories. For instance, not a single American-owned firm currently builds transit rail cars. U.S. imports of machinery exceeded exports by $15.8 billion, or 27 percent, in 1985. By comparison, only a decade ago, our machinery exports exceeded imports by 58 percent.



> *"We have lost a generation of talent in transportation because we haven't been putting money to support R&D through universities."*
>
> Dr. Robert Paaswell, Executive Director,
> Chicago Transit Authority
> Council Hearing,
> Chicago, Sept. 30, 1987

Other developed countries give greater support to public works R&D and technical innovation. Most of our trading partners invest a larger share of GNP in infrastructure R&D than the U.S. In addition, Japan and many European governments support R&D through tax incentives or matching funds, as well as flexible bidding and contracting arrangements. Major Japanese construction firms, although they had less than two-thirds the contract volume of their American counterparts, spent ten times as much on R&D in 1985. A sustained investment of this magnitude is likely to produce an increasing number of "cutting-edge" technologies that will find their way into the American public works construction market.

With nearly a trillion dollars of infrastructure fixed assets already in place in the United States, small changes in the reliability or efficiency of key components can result in major cost savings. However, we also face emerging problems of immense technical complexity—such as groundwater contamination, hazardous waste disposal, and traffic and airport congestion—that demand much more than tinkering with current methods. Technology is not the total answer, but clearly it is an essential part of it.

"Science and technology are fundamental to U.S. competitiveness. America's preeminence in research and innovation has long been the envy of the world and a critical source of our national strength.

President Ronald Reagan
State of the Union Message
1987

Currently, no federal agency or other organization has the primary responsibility for systematically focusing national R&D efforts on infrastructure problems. Current federal programs are spread over a number of agencies with narrowly targeted missions. Ongoing research efforts conducted by other levels of government, professional organizations, and the private sector are fragmented and aimed only at incremental improvements. The opportunities for major breakthroughs and for sharing research results among all groups often are very limited.

The Council concludes that the scope and complexity of infrastructure problems throughout the United States merit a far more intense national focus on public works technology. This focus should be comprehensive—encompassing all infrastructure categories. It should be cooperative—involving representatives of all levels of government, professional organizations, and the private sector. Finally, it should be coordinated—tying together and building upon current R&D efforts.

While federal leadership and a continuing national framework are necessary, this approach need not require a large new federal bureaucracy. The Council believes that the goal of accelerating public works innovation would be served best by regional centers responsive to the public works market and particular variations and requirements within their respective geographic areas. Such centers could be either university based or operated in conjunction with existing research institutions.

Models for this approach are readily available. The National Science Foundation recently established specialized Engineering Research Centers at a number of universities. Each is focusing on a major topic of interest in engineering—for example, systems engineering for large structures at Lehigh University—with the aim of developing a center of excellence in its field. The Department of Transportation is in the process of creating ten regional university-based centers for R&D.

The Council also recognizes that the significant technical, financial, and legal risks involved with innovation can deter development and application. Risk-sharing arrangements for demonstration projects that test technology in an operating environment can help overcome these barriers. The size of many projects and the degree of risk involved may require a federal role. The federal government has assumed such responsibility in the past—most notably in the field of energy development—and the extent of our infrastructure needs may justify its doing so again.

Funding for efforts to expand infrastructure innovation should be provided by all levels of government and the private sector, with additional support from consumers as well. The latter could be collected in the form of a small assessment on utility bills earmarked for research and development in areas related to the source of funds. For instance, a 10 cent monthly assessment on year-round housing served by public sewers would yield over $77 million a year. A small percentage of public infrastructure capital funds also could be set aside for R&D. Potential sources include dedicated revenues, grants, trust funds, and general revenue contributions to capital budgets.

The Council also recognizes that to encourage and implement innovative technology, we must provide adequate education and training for the people who build, manage, and operate public works. These tasks demand increasingly complex technical and professional competencies, particularly in the areas of maintenance and rehabilitation.

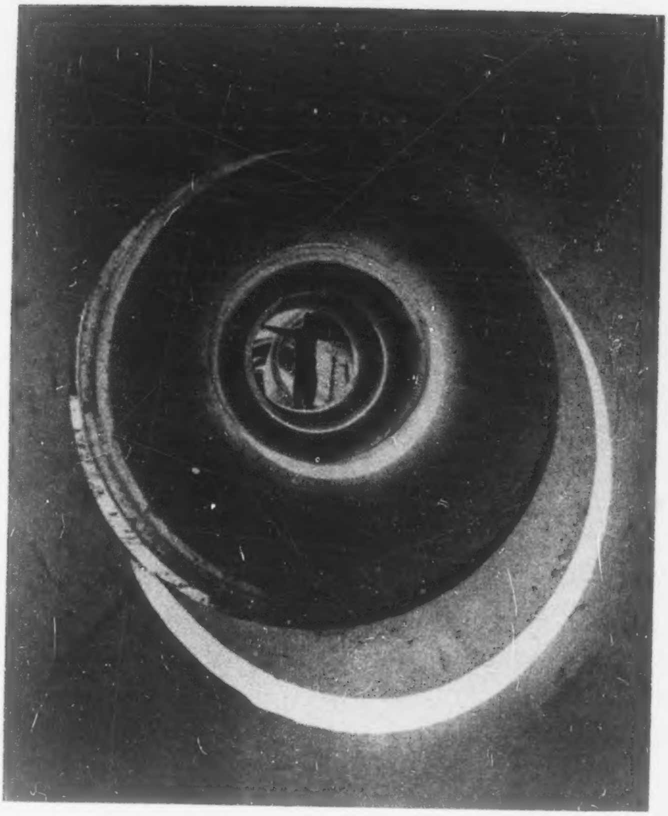
Enrollments in schools of civil engineering—traditionally the mainstay of the public works profession—are declining significantly just as many senior engineers are reaching retirement age. Over the period 1985–1989, about 16 percent of all engineers in state transportation agencies are expected to retire; in some states the figure will exceed 20 percent. Yet between 1984 and 1987, the number of bachelor degrees awarded in engineering declined from 76,931 to 71,372. The share of degrees awarded in civil engineering has been falling rapidly: from about 20.3 percent in 1976 to 15.7 percent in 1982, and then to 12.8 percent in 1984. In addition, civil engineering graduates often have more financially rewarding job opportunities than are available in public works agencies.

The Council concludes that the nation has a shortage of technically competent personnel to meet future requirements of the public works profession. Federal action is needed to support and stimulate the education and training of public works professionals from all disciplines and academic specialties. Government agencies and private organizations should conduct an aggressive and sustained campaign to encourage young people to enter the profession. Major professional organizations such as the American Public Works Association and the American Society of Civil Engineers already have taken the initiative on this issue.

"There should be an immediate national concern for the provision of public works management training for the next generation of leaders in this field."

Max Whitman, Director of Public
Works, Village of Winnetka, Illinois
Council Hearing,
Chicago, Sept. 30, 1987

However, they should receive much more active support from government, business, and the education community. In addition, specialists from a range of other fields who could apply fresh perspectives should be encouraged to join the public works profession. Finally, retraining and continuing education programs should be utilized to upgrade the skills and abilities of current staff members.



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A Strategy for Improving America's Public Works

No single approach is adequate to ensure the future viability of America's infrastructure. A broad range of measures is necessary to make a meaningful difference by the turn of the century. Specifically, these should include:

- **A national commitment, shared by all levels of government and the private sector, to increase capital spending by as much as 100 percent above current levels;**
- **Clarification of the respective roles of the federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability;**
- **More flexible administration of federal and state mandates to allow cost-effective methods of compliance;**
- **Accelerated spending of the federal highway, transit, aviation, and waterways trust funds;**
- **Financing of a larger share of the cost of public works by those who benefit from services;**
- **Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing;**
- **Strong incentives for maintenance of capital assets and the use of low-capital techniques such as demand management, coordinated land-use planning, and waste reduction and recycling;**
- **Additional support for research and development to accelerate technological innovation and for training of public works professionals; and**
- **A rational capital budgeting process at all levels of government.**

None of these steps will be easy or unopposed. But the increasing cost of delay is certain. The Council urges the President, the Congress, and the nation's state and local leaders to act on this agenda immediately.

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